

CHEMISTRY

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SALT WATER INTO FRESH

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Editorial:

And After B. S.?

Inside Front Cover

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JANUARY
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thirty-third
Year

A SCIENCE SERVICE PUBLICATION

And After B.S.?

➤ MANY OF US must have read with interest the results of the American Chemical Society survey, published in the Chemical and Engineering News, October 19, 1959, on the starting salaries of graduates in chemistry and chemical engineering. A student must indeed be dedicated to science not to be interested in his future remuneration potential!

Three of the most striking lessons to be drawn from these statistics are these: The chemical engineers are paid rather more than the pure chemists. The difference in *monthly* median income ranges from \$46 at the B.S. level to \$25 at the Ph.D. level.

Overall starting salaries increased by an average of 3 per cent between June 1958 and June 1959, a further indication that the field of pure and applied chemistry is still expanding rapidly.

Perhaps most striking of all are the pay differences between the bachelors, masters, and doctors in both fields. The median monthly salaries of B.S., M.S., and Ph.D. graduates in chemistry are \$434, \$525, and \$700 respectively, while those in chemical engineering are \$490, \$560, and \$725.

It is evident from these figures that the extra one to four years required, after graduation as a bachelor, to obtain an M.S. or a Ph.D. is well worthwhile from a purely mercenary view-point. There are at present more sources of income, assistantships, fellowships, and so forth, than there are suitable students ready to take advantage of them, so that the cost of graduate education is largely in the time involved.

From a more scientific standpoint, a graduate degree is equally desirable. The higher one's degree, in general, the greater will be one's independence and responsibility in research, and the greater one's opportunity to use initiative and imagination rather than perform dull, routine work.

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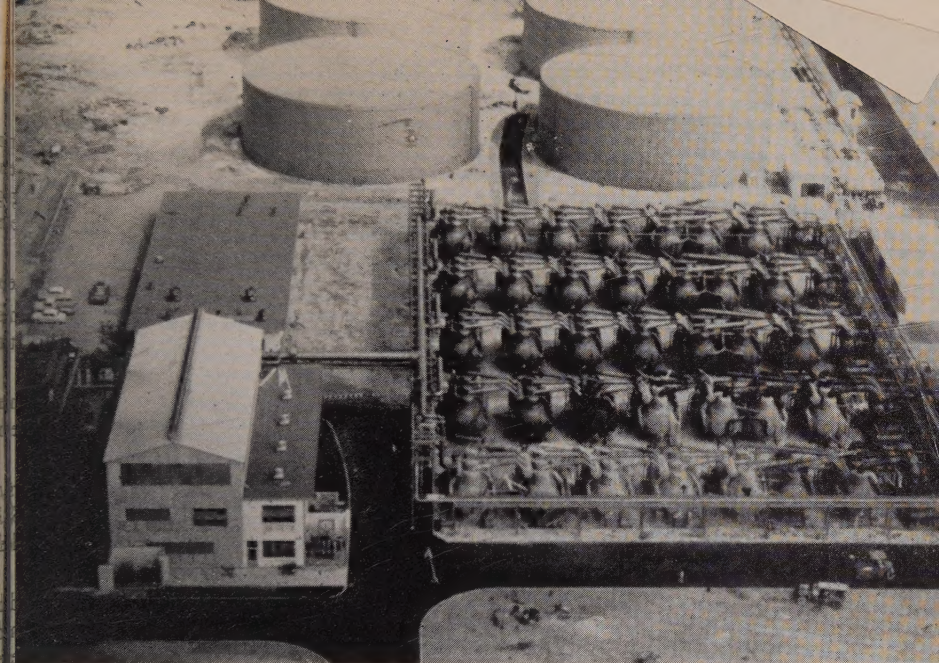
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➤ SALT WATER BECOMES DRINKING WATER *in these huge evaporators, part of the world's largest single installation for converting sea water to fresh water. Located at Aruba in the Netherlands Antilles, the \$11,000,000 plant was designed and built by Singmaster & Breyer, New York engineers. It has a rated capacity of 2,700,000 gallons of fresh water per day, plus 15,000 kilowatts of electricity.*

Salt Water to Fresh

The world's supply of fresh water, though abundant, is not equally distributed. This, together with the rapidly increasing demands placed upon natural sources, compels us to seek economical methods of converting salt water into fresh.

by RICHARD LITELL

➤ "THERE IS no small pleasure in sweet water," the poet Ovid said 2,000 years ago.

There is no less pleasure today, but available "sweet" or potable water is becoming less and less plentiful.

The predicted increase in water use during the coming decades makes it

unmistakably clear that we will need more water than can be provided from readily available natural sources.

Although neither the nation nor the world is really short of water, the amount of usable water is not evenly distributed.

The United States, for instance, gets an average 30 inches of rain a year, amounting to 4,300 billion gallons of water a day. But because of unequal distribution, an area such as the Washington coast west of the Olympic Mountains may get 100 inches a year, while another region in the same state may get only 10 inches.

In 1957, more than 1,000 U. S. communities — the home towns of one-seventh of our entire population — endured water shortages to some degree, varying from lack of water for lawns and gardens to an actual absence of drinking water. And this was not a freak year.

So it is becoming increasingly clear that, despite the abundance of this vital resource, its lack of even distribution among the world's 2.9 billion people and its ever growing utilization compel us to find new sources and soon.

The most obvious sources are the 320,000,000 cubic miles of salt water found in the world's oceans, and the less salty brackish waters found on land.

Scientists now hope to end a centuries-long search for a practical and economical method of converting salt water to fresh.

Fresh water is commonly defined as water containing less than 1,000 parts per million of dissolved salts. Salinity of waters available for conversion varies greatly, with the oceans being fairly uniform at about 35,000 parts per million. Some seas may have as high as 40,000 parts and others as low as 7,000 parts.

Any water less salty than sea water but with more than 1,000 parts per million is called brackish. Brine is

water containing even more dissolved salts than sea water.

What makes sea water salty are the 40 to 50 dissolved elements found in it, chiefly sodium chloride. Man cannot live on this water, which is three or more percent salt, because the most his kidneys can secrete is a two percent salt solution.

So, for every quart of sea water he drinks, his body will give off one and a half quarts of urine to get rid of the excess salt. Because body water must make up the difference, he will become more and more dehydrated.

So great is the expanding use of fresh water by our increasingly urbanized and industrialized population, that the average per capita consumption of water in this country has gone from 600 gallons a day in 1900 to 1,100 gallons today. Americans now use 250 billion gallons of water a day and the total may increase as much as 70% by 1975.

It takes 15 gallons of water to take a three-minute shower, 3,000,000 gallons a day to air-condition a large building, 65,000 gallons to produce a ton of highly finished steel, and 2.5 gallons to make a phonograph record.

Industrial uses accounted for an average of 110 billion gallons of water a day in 1955. Needs in 1975 are estimated at 215 to 265 billion. Fortunately about 90% of water withdrawn for industrial use can be recirculated or returned to streams for other uses.

Irrigation, however, is the greatest consumer of water, using up more than 1,000,000 gallons daily. It takes 115 gallons to grow enough wheat to make one loaf of bread and 1,000,000 gallons per season to grow an acre of alfalfa.

Attempting to convert saline water to fresh is hardly a recent undertaking. Man has sought for centuries for practical and economical methods.

Already today, in areas of the world where cost is not the chief consideration, there are an estimated 500,000 people living on some 12,000,000 gallons of converted salt water daily. The

largest conversion plant is on the Caribbean island of Aruba. It turns out 2,700,000 gallons of fresh water a day.

Technically, it is not too difficult to change salt water to fresh. The big problem is expense. But, while the cost of natural fresh water is rising constantly, the cost of converting sea water is coming down.



► THIS PROTOTYPE PLASTIC STILL at Daytona Beach, Fla., converts sea water to fresh by solar distillation at a rate of about 100 gallons a day. The sun's rays heat the salt water, which vaporizes and condenses on the underside of the plastic or glass covers. Fresh water then runs down the sloping surfaces and is collected.

Just prior to World War II, the cost of conversion ranged upward from \$4 per 1,000 gallons. In several plants now in the planning stage, successful conversion is expected to cost less than \$1 per 1,000 gallons. New processes, not far enough advanced to be considered for demonstration plant programming, give promise of lowering the conversion cost below 50¢ per 1,000 gallons.

Present city water costs in the U. S. average about 30¢ per 1,000 gallons.

The scores of different conversion processes may be classified into five main groups.

First, is the distillation of sea water through artificial heat, which contains several methods that are the farthest advanced today.

Second, is solar distillation. Using the energy from the sun, this method has the advantage of eliminating the cost of fuel energy otherwise required. But it also has the disadvantage of difficult research and development problems.

Another group of processes are those involving the use of membranes, whose greatest area of application will be in the treatment of brackish water. Electrodialysis processes are the only membrane conversion methods that have thus far advanced beyond the laboratory stage.

Freezing processes are very new and have certain inherent advantages that

could make them competitive with the better distillation processes.

The fifth main group includes other chemical, electrical or physical conversion methods. Its farthest advanced process is that of solvent extraction, also expected to be most promising in converting brackish water.

In 1952, the U. S. Government set up the Office of Saline Water and began sponsoring research in the field of large-scale conversion of salt water.

In 1958, the expenditure of \$10,000,000 was authorized for the construction of not less than five demonstration plants to test some of the more advanced conversion processes.

Three of these were to be sea water plants to be located on the East, West and Gulf Coasts, and two brackish water plants, to be located in the northern Great Plains and the arid Southwest.

So far, the processes to be utilized at four of the five plants have been designated and the actual sites of the first two plants have been selected. A decision on the last process is due in March and two more site selections are due this month.

The Gulf Coast plant will be located at Freeport, Texas, and will convert sea water by long-tube vertical multiple effect distillation. San Diego is the site of the West Coast plant which will also convert sea water, but by multi-stage flash distillation.

Yttrium May Go into A-Plane

➤ A BLUE-GRAY MEMBER of the rare earth family, yttrium, holds promise as a metal for use in an atomic-powered airplane's reactor.

K. M. Bohlander of General Elec-

tric's Aircraft Nuclear Propulsion Department, Cincinnati, Ohio, told a symposium that the only problem in machining yttrium has been a tendency of small particles to catch fire

Yttrium's most extraordinary effect has been increasing oxidation resistance in iron-base metals containing chromium. A little yttrium added to stainless steel containing 25% chromium gives the metal the same oxidation resistance at 2,500 degrees Fahrenheit as it had at 2,000 degrees, it was reported. Addition of aluminum or thorium further increases oxidation resistance.

Use of yttrium as an alloying agent when sparking occurs at the working point.

This has been solved by flooding the work and cutting tool with an oil coolant, he said.

The symposium, sponsored by the American Society for Metals and the Atomic Energy Commission, also heard how "pinches" of yttrium when added to other metals help increase resistance to oxidation under high temperatures.

also improves the workability and physical properties of the metal. The iron-chromium-yttrium alloy is "readily cold-rolled, easily welded and represents a significant development in high-temperature metallurgy."

Other studies showed that yttrium removes oxygen and nitrogen from vanadium to improve ductility. In tests, unalloyed vanadium cracked extensively when cold-pressed and cold-rolled. But after 0.5 to two percent of yttrium was added, the metal could be cold-rolled to a thin strip with only slight edge roughness.

General Electric is one of two companies working under a Government contract on development of an atomic reactor for America's first nuclear-powered airplane. Although other rare-earth metals have been investigated, concentration is on yttrium because of its good structural strength and ability to absorb neutrons.

Liquid Fluidized Bed Reactor

A Martin Nuclear Division Report

► THE PEACEFUL benefits of atomic energy have expanded amazingly in recent years, but even today the atom cannot compete economically with conventional fuels in generating electricity to light our big cities and to drive our street cars.

The Liquid Fluidized Bed Reactor, or LFBR, could provide the means of cutting production and maintenance costs sharply in the field of large-scale nuclear power. Its design aims at simplifying the operation of a power reactor by eliminating the need for certain components. It also seeks to reduce costs in the overall "fuel cycle", a continuous process in which: 1) fis-

sionable material is put into usable form; 2) part of the fissionable fuel is transformed into power in the reactor system; and 3) the unused fuel is reclaimed for use again.

In order to explain clearly the operation and potential advantages of the LFBR, let's look first at the principles underlying *any* nuclear reactor. Perhaps the most important of these is the process called "chain reaction."

There are several different kinds of Uranium, of which two are important to this explanation. The more common variety is called U-238, while the second is called U-235. Using the standard equipment of a chemist, we

can't tell these two "isotopes" apart; but to a nuclear scientist they are as different as night and day.

If a tiny particle called a "neutron" hits the "nucleus" or core of a *U-238* atom, the neutron may be "captured," in which case the atom will eventually turn into a completely new substance, called Plutonium. Very little energy is released in this way, however, and that's the end of the reaction.

On the other hand, when a neutron is absorbed by a *U-235* atom, the nucleus of the atom becomes unstable and usually flies apart. This process, called "nuclear fission," releases a considerable amount of energy. The secret of the "chain reaction" is that fissioning Uranium also releases two or three *extra neutrons*. If conditions are just right, enough of these extra neutrons will split *additional* *U-235* atoms (releasing still *more* neutrons) so that the fission process has a chance to grow, or at least to continue on its own in a kind of endless chain.

In an atomic bomb, the idea is to let the fission process spread very, very rapidly, releasing an enormous amount of energy all at once. In a nuclear reactor the process is slowed down, and controlled, so that heat can be produced gradually.

Because *U-235* is very rare, costly and hard to separate from other isotopes of Uranium, the fuel of many reactors consists of only a small amount of *U-235* mixed with a large quantity of *U-238*. In order to produce a chain reaction in such a mixture, however, something must be done to make a fairly large percentage of the neutrons ignore the *U-238* and seek out the *U-235* atoms.

Scientists have discovered that this can be done by controlling the speed of the flying neutrons. When neutrons are slowed down to relatively low speeds, they are less likely to be absorbed by *U-238*; but these same slow-moving neutrons are gobbled up readily by atoms of *U-235*. For this reason, a substance called a "moderator" is added to slow down the neutrons within a reactor without absorbing them. The moderator material may be solid (like carbon) or a liquid (like water).

Since energy is released by nuclear fission in the form of heat, a "coolant" is also passed through the core to absorb the heat and carry it off to some point outside the core where it can be put to use, either as heat (through a conversion process) or as electricity. When water is used as a moderator, it frequently doubles as the coolant.

Fuel elements themselves have been made in many forms. Sometimes the fissionable material is put into the shape of plates, coated with a metal like stainless steel. Other reactors use elements shaped like rods or like tubes. In some cases, the fuel is put into liquid form and simply *mixed* with the moderator.

The fission process in all reactors now in operation is turned off and on by the movement of "control rods" in and out of the reactor core. These rods are made of a non-fissionable material which soaks up stray neutrons like a sponge. If the rods are pushed into the core, they take neutrons out of circulation as soon as they are produced and before they get a chance to split more atoms. As the rods are withdrawn gradually, the chain re-

action builds up. Control rods are also designed so that they can be rammed into the core quickly in case of emergency.

In a liquid fluidized bed reactor, the fissionable fuel is in the form of pellets about a quarter of an inch in diameter (either spheres or modified spheres). The pellets may be coated with nickel, zirconium or some other metal, or they may be bare fuel.

The pellets are completely immersed in water or some other suitable liquid inside an upright cylinder. The cylinder has an inlet at the bottom and an outlet at the top. When the reactor is not in operation, the pellets rest on a perforated plate with holes large enough to permit rapid water flow but small enough so that the pellets can't fall through.

In this "collapsed" position, the small amount of U-235 in the bed of pellets will not support a chain reaction. There simply isn't enough room between the pellets for the amount of liquid moderator needed to slow the neutrons down to an efficient "splitting speed."

If pumps cause the liquid to surge upward and to force its way through the pile of pellets, however, the pellets will tend to rise and separate from one another to make room for the upward-flowing liquid. By controlling the flow carefully, the pellets can be separated by *just enough* liquid to maintain a power-producing chain reaction. Preliminary studies indicate that there is a reasonably wide range in which an efficient reaction could be maintained.

One big potential advantage of the LFBR is that it could lead to the complete elimination of control rods and

all of the complicated actuating equipment associated with them. It can be turned on and off simply by adjusting the flow rate of the water.

The LFBR would also include an attractive built-in safety factor. If a failure in any part of the overall system caused the flow rate to drop, the pellets would all fall to the bottom and the reaction would stop. The pump could easily be designed so that the flow rate could not *exceed* the proper limits under any circumstances.

Perhaps an even greater advantage for the LFBR lies in the fact that fuel pellets are potentially much easier to fabricate than the elements now in use. They are also obviously easier to install and remove.

In practice, a certain percentage of the fuel pellets would probably be replaced periodically, a process called "continuous refueling." This would by-pass the dual problem of building complete replacement cores and shutting down the reactor from time to time to substitute a fresh core. Continuous refueling would also permit operation over a long period of time with less of the costly fuel tied up in the reactor itself at any one time.

Because of the large area of contact between the thousands of pellets and the liquid, heat transfer would be extremely efficient. The liquid moderator, of course, can also act as the coolant.

Studies indicate that over a period of time the U-235 would be used up uniformly, within all of the pellets, which makes for efficiency in refueling. Furthermore, since there is no structural material inside the core to absorb neutrons, the conversion of U-238 into Plutonium is expected to be

higher than in most other types of reactors. This is important, because Plutonium itself is fissionable and so is a valuable by-product.

Many problems must be solved before the advantages of the LFBR can be realized on a practical basis. Work at present is still in the research and development stage, and the answers to many of the questions about the system must await the construction

and operation of the first actual test core.

In the long run, however, the inherent simplicity of the LFBR design may make it the first nuclear reactor system to produce electrical power at a reasonable commercial fuel cost. For this reason, current progress on LFBR brings the Atomic Age dream of abundant, low-cost power for all just a little closer.

New Use for Starch

➤ A CHEMICAL curiosity which has retained its enigma for more than fifty years has finally been resolved through the efforts of a researcher at Newark College of Engineering.

Dr. Charles L. Mantell, chairman of NCE's Chemical Engineering Department and a member of the Board of Directors of the NCE Research Foundation, has found a way to convert common starch into the previously too-expensive-to-produce dialdehyde starch. According to Dr. Mantell, dialdehyde starch is important as a tanning agent to produce a smooth and soft white leather; a paper strengthener; a lotion base for cosmetics; a binding base for tobacco; and in the preparation of some pharmaceuticals such as cortisone.

The success of Mantell's experimentation has been described by the Department of Agriculture as the first breakthrough in fifty years in finding new markets for surplus starch. The machine which does the converting has been nicknamed the "Behemoth" (an animal described in the book of Job closely resembling the hippopotamus), and weighs over 4,400 pounds. It consists basically of a series of

chambers in which starch is oxidized. As explained by Dr. Mantell, the machine converts iodine into periodic acid, which acts upon ordinary starch converting it to its new form, dialdehyde starch. The iodine compound resulting from this chemical action instead of being wasted is extracted from the starch mixture and regenerated so that it may be used over and over again repeating the process of manufacturing dialdehyde starch.

Dr. Mantell's "Behemoth" is now producing enough periodic acid to make one ton of dialdehyde starch a day but, Mantell pointed out, by adding additional chambers the machine could produce as much as desired. Dialdehyde starch was previously made in the laboratory at a cost of about \$50.00 per pound, but was rarely, because of the cost, ever produced in quantities larger than a gram.

The project of manufacturing huge quantities of dialdehyde starch was started by Dr. Mantell and his associates almost two years ago as a result of a direct request and grant of \$70,000 from the northern regional laboratory of the Department of Agriculture in Peoria, Illinois.

Association of Vitamin Chemists

▶ THE ASSOCIATION of Vitamin Chemists was incorporated as a non-profit scientific organization in 1944, following a series of informal meetings beginning in September 1943. To quote from the Constitution of the Association, "The purposes of the Association are to provide a medium for the interchange of ideas and information pertinent to vitamin chemistry and technology; to stimulate the study of vitamin methodology; and to increase the fund of knowledge pertaining to vitamins.

The Association strives to achieve its purposes through three continuing activities.

Regular Association Meetings

Monthly meetings of the Association of Vitamin Chemists are held from October through May. With few exceptions, these meetings are held the second Thursday of each month, beginning at 7:30 p.m. Although its membership is international, all meetings are held in Chicago, Illinois, usually at the Illini Union Building at 715 South Wood Street. The meetings, which are open to the public, have as the main feature of the program an address by a prominent and highly qualified scientist, presenting original, frequently unpublished, data on vitamin technology, nutrition and disease. Abstracts of the papers presented at these meetings are made available to all members in the monthly *Proceedings of The Association*.

The program for the 1959-60 season is typical; from the standpoint of the caliber of the speakers and the range of subject matter, of past programs of the Association. In October of 1959, Dr. R. S. Gordon of Monsanto Chemical Company spoke on antioxidants in animal feeds. In November 1959, the speaker was Dr. J. Stamler of the Chicago Board of Health who spoke on studies of epidemiology and prevention of atherosclerotic heart disease. The December 3rd speaker was Dr. George Wolf, of the University of Illinois, whose subject was "Metabolism and Function of Vitamin A."

At the January 21st, 1960 meeting, Dr. O. Wilder of the American Meat Institute will discuss energy value of fats. Protein and amino acid requirements of swine will be discussed by Dr. D. E. Becker of the University of Illinois on February 11th. On March 10th, Dr. P. E. Waibel of the University of Minnesota will address the Association on recent developments in poultry nutrition. At the last meeting of the current year, May 12th, Dr. Richard J. Block of the Boyce Thompson Institute will speak on protein and amino acid supplementation.

In addition to its regular meetings, the Association holds other meetings at which subjects of more specialized interest are discussed in detail. These usually are seminars and symposia on developments in laboratory procedures and instrumentation. Proceedings of such meetings, as deemed appropriate,

ate, receive special publication and are circulated to the membership.

Vitamin Abstracts

The publication of *Vitamin Abstracts*, a quarterly abstract journal, was begun by the Association in 1947. A large portion of the world's scientific literature is reviewed and those papers dealing with vitamins are abstracted in *Vitamin Abstracts*. Currently, some 20 members of the Association provide abstracts from approximately 100 journals.

Since abstractors and editorial services are contributed by the members of the Association, the subscription price for *Vitamin Abstracts* is a reasonable \$6.00 per year for non-members and \$4.00 per year for members. As might be expected, this modest price does not allow for an elaborately printed and bound publication. *Vitamin Abstracts* is a mimeographed publication with each of the 14 recognized vitamins abstracted on separate pages. Two other headings, "Other Vitamin Factors" and "General" are also on separate sheets. This arrangement allows the journal to be separated and a continuous file relating to abstracts on individual vitamins conveniently maintained.

A recent innovation has been to separate assay methods for vitamins from all other abstracts relating to the vitamins. Thus, it is possible to have a methods file for individual vitamins, conveniently constructed from the original *Vitamin Abstracts*.

Methods of Vitamin Assay

An important contribution to the realization of the purposes of the Association has been the publication of the book "Methods of Vitamin As-

say." The first edition was published in 1947 and a second in 1951. The methods described are a result of the pooling and interchange of information on analytical techniques and thus represents the combined knowledge and experiences of many persons. The Methods Committee, which was responsible for the publication of both editions, continues to be a most important activity of the Association. It is charged with the responsibility of continuous study of vitamin methodology for the purpose of making additional revisions when justified by reliable new information.

In order further to implement the standardization of vitamin methods by encouraging the comparison of results of different laboratories on the same samples, a large number of replicate portions of four representative foods were prepared for distribution by the Committee on Collaborative Assay. After agreement had been reached on the vitamin concentrations of these foods, the samples were used as standards. By analyzing a sample with known vitamin content along with a series of unknown samples the analyst had a means to check the reliability of the method used. Distribution of check samples was discontinued several years ago because other and generally more reliable reference materials became available.

Qualifications for membership in the Association are an academic degree in the basic or applied sciences or the equivalent in experience, and 2 years experience in the field of vitamin chemistry, technology, nutrition or related fields. Correspondence should be addressed to the Association of Vitamin Chemists, 2549 West 63rd Street, Chicago, Illinois.

✓ Chemistry Quiz ✓

Directions: Mark the answer you think *most nearly correct*.

Answers are on page 36.

- A. What is the missing word in the following sentence? "Primary cosmic rays consist chiefly of _____ outside the earth's atmosphere."
1. electrons
 2. ions
 3. neutrons
 4. positrons
- B. Sillimanite is a material frequently used in the manufacture of
1. ball bearings
 2. nylon stockings
 3. paint remover
 4. spark plugs
- C. The *chromosphere* is a layer in the atmosphere of
1. Saturn
 2. the earth
 3. the sun
 4. Venus
- D. Male hormones are called
1. androgens
 2. cortisone
 3. estrogens
 4. pituitrin
- E. Which of the following classes of radiation phenomena have the longest wave length?
1. gamma rays
 2. Hertzian radiation
 3. ultraviolet light
 4. X-rays

Complete copies (with answers and norms) of many previous Science Talent Search examinations are available at 15c each from Science Service, 1719 N St., N.W., Washington 6, D. C.

Radioactive Wastes Stored in Glass

➤ BOTH Canadian and Russian scientists have made good progress in their attempts to incorporate highly radioactive wastes into glass in order to store them safely in artificial vaults or bury them underground.

Scientists working with the Atomic Energy of Canada Limited have succeeded in making glass containing up to 50 curies of five- to six-year-old mixed fission products per kilogram.

One of the problems during the infiltration process of the radioactive wastes into the glass, volatility of two fission products, ruthenium and cesium, has successfully been overcome by the use of iron oxide as an adsorber

for ruthenium and a silicate for the adsorption of cesium. The experiments also proved that the rate of leaching of fission products depends on the composition of the glass. Very little leaching occurs and this decreases with time.

The method of ultimate storage depends both on the properties of the glass and the concentration of fission products in it. In case of short decay times of the radioactive isotopes contained in the glass artificial cooling might become necessary in order to avoid an undesirable increase of temperature in the burying grounds. While artificial cooling would probably be

too expensive, adequate cooling can be achieved by burial in dry ground.

L. C. Watson, when presenting these findings of the Atomic Energy of Canada Ltd. to his colleagues during the international meeting in Monaco organized by the International Atomic Energy Agency and UNESCO, also indicated that a demonstration plant is expected to be built to incorporate all existing wastes stored at Chalk River into glass. This glass would then be used for a large-scale test of a selected method of disposal.

P. V. Zimakov of the USSR said

that the problem of incorporation of highly radioactive wastes into glass under high temperatures has also been studied in his country. Soviet scientists, however, have not succeeded in making the product completely insoluble. They consider that any further improvements in the insolubility would depend on a reduction of the size of the crystals in the glass and on other chemical factors. Mr. Zimakov agreed that the fixation of highly radioactive waste into glass before burial of waste products would increase the safety.



"10 - 9 - 8 - 7 - 6 - 5 . . ."

New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupons (but not stamps) for each patent ordered.

Radioactive Battery Invented

➤ A RADIOACTIVE BATTERY in which the energy of charged particles emitted by a radioactive isotope is converted into heat energy and then into electricity earned patent No. 2,913,510.

Inventors John H. Birden and Kenneth C. Jordan of Dayton, Ohio, aimed at producing a novel radioactive voltage source of inherently low internal impedance, so that large amounts of useful power might be delivered by a source of reasonable physical size.

They also sought to provide a radioactive battery that creates no radiation hazard of any kind to the user or to equipment. They assigned their invention to the U. S. Atomic Energy Commission.

Wax Coating Inhibits Coffee "Perspiration"

➤ EVEN COFFEE beans "perspire," and a German inventor has come up with a way to stop it.

During roasting, coffee has a tendency to exude moisture. This, in conjunction with escaping air from the bean interior, is apt to cause oxidation at the bean surface, which in turn causes the coffee to take on an unpleasant, old, stale and rancid odor.

Efforts to protect coffee beans against oxidation by coating or glazing them with harmless resins and

waxes other than coffee wax have met with unsatisfactory results, according to Max Specht, late of Hankensbuttel, Germany.

Mr. Specht received patent No. 2,917,387 for a method of preventing coffee bean perspiration that involves applying a protective coat of coffee wax extract to green surfaces prior to roasting. The wax extract is obtained during the process of removing caffeine from the beans. This coating inhibits the escape of moisture, air and coffee oils during roasting without giving the beans an undesirable oily appearance.

Aluminum and Thorium Bonded by New Method

➤ A METHOD of forming a strong metallurgical bond between aluminum and radioactive thorium has been patented. It has application in the nuclear energy field where thorium fuel elements are coated with aluminum to facilitate heat transfer and prevent corrosion.

Bonding the two metals is difficult because of their dissimilar nature. Earlier aluminum-thorium bonds have been produced, inventor Samuel Storchheim, of Kingston, Pa., reports, but they have lacked the necessary thermal stability for service at high temperatures. Trouble was experienced in the form of warpage, weld breakage and separation of the bond.

Another difficulty has been the

rapid growth of layers of brittle, intermetallic compounds of thorium and aluminum at the bond interface.

Mr. Storchheim's method, for which he received patent No. 2,914,847, aims at overcoming the difficulties of earlier bonding techniques.

It comprises placing clean surfaces of thorium and aluminum in contact with each other and hot-pressing the metals together in an inert atmosphere or under a vacuum. By hot-pressing at a temperature range of about 700 degrees to 1,000 degrees Fahrenheit, a strong, adherent bond is obtained. Patent rights were assigned to the Atomic Energy Commission.

Jet System Operates in Water

► DR. FRITZ ZWICKY, physicist at California Institute of Technology, Pasadena, has invented a jet-propulsion system that can operate in water.

This is made possible by the use of chemicals that react violently and spontaneously with water, such as alkali metal borohydrides and metal hydrides. The gaseous products of the

reaction produce a mass driving effect against the fluid in the channel, forcing it through the exhaust nozzle to create the propulsive force.

The system, for which Dr. Zwicky received patent No. 2,914,913, is self-starting and can drive itself at both very high and low speeds.

Patent rights were assigned to Aerojet-General Corporation, Cincinnati.

Milk Better Preserved By Freezing

► PRESERVATION of milk by freezing has not proven entirely satisfactory because of the tendency for the fat in the milk to separate out when the milk is thawed. William Gardiner, Wearmouth of Reading, England, has found that milk subjected to vibrations at ultrasonic frequencies can be stored in a frozen state for a relatively long time without this undesirable fat separation on thawing.

He received patent No. 2,918,380 for a method by which milk is first pasteurized, then vibrated, filled into sealed packages and dipped in a cold liquid for freezing.

From Refrigerator to Satellite

► A CHEMICAL originally developed as a refrigerant is now helping keep the nation's Discoverer satellites positionally stable as they spin around the earth collecting data that will help advance the nation's future space programs.

Used along with nitrogen to provide the thrust in tiny reaction jet nozzles on the final stage of the Discoverer, the chemical is Du Pont's "Freon-14" tetrafluoromethane, a

compound that boils at minus 198 degrees Fahrenheit. In the satellite's guidance system, it spurts out of the gas jets, providing enough thrust or push to change the attitude of the satellite as it hurtles around the globe at speeds of more than 18,000 miles per hour.

In fact, the miniature reaction jet nozzles, powered by the mixture of Freon and nitrogen and controlled by electronic guidance signals, are respon-

sible for the attitude control of the Discoverer from the moment the final stage of the space-probing vehicle separates from its Air Force Thor booster.

From that point on, the tiny jet engines, which are mounted in the Discoverer, can be operated either singly or in any desired combination to keep the satellite in the proper attitude. The entire pneumatic attitude control system weighs about 70 pounds, including the torque motors and thrust nozzles, pressure regulator, propellant lines, manifolds, and metal "bottle" containing the supply of nitrogen and Freon propellant.

Freon was chosen as the propellant in the orbital guidance system, engineers explain, because it packs a lot of power in a small weight space.

At a predetermined point and on a selected pass, the nose cone, or re-entry vehicle, can be fired out of orbit into a trajectory calculated to bring it back to earth.

Of the eight Discoverer satellites launched by the U. S. Air Force Ballistic Missile Division from Vandenberg Air Force Base in California by

December 1, 1959, all but the first have been equipped with the orbital guidance system using Freon propellant.

The Discoverer satellite vehicle is designed and built by the Lockheed Missiles and Space Division at its Sunnyvale, Calif., plant. Major subcontractors to Lockheed and participating contractors on the Discoverer project include Bell Aircraft, which supplies the satellite propulsion system; Philco Corporation, which supplies ground and space communications components; and General Electric, which provides the re-entry vehicle and recovery capsule. The 150,000-pound thrust Thor ballistic missile used as the first-stage booster to launch the satellite toward orbiting altitude, of course, is supplied by the U. S. Air Force.

The final stage engine, provided by Bell Aircraft under a subcontract to Lockheed, is an integral part of the satellite and, after burnout, remains with the orbiting vehicle. It burns a super-powerful fuel called unsymmetrical dimethylhydrazine, with a red fuming nitric acid as an oxidizer.

Metal Process Developed

► LARGE METAL objects from tungsten, molybdenum and other superstrong, high-temperature metals and alloys may be constructed as a result of a new process developed. The process compresses metal powders as fine as flour into large, uniform metal bars of unlimited length. When baked in an oven, these are fashioned into useful structures by standard metal-working procedures.

Known as continuous powder compaction and developed by Westinghouse Electric Corporation, the technique works as well with non-metal ceramic powders as it does with metals.

Until its discovery, attempts to prepare large bars, strips or sheets from powders were expensive, cumbersome and technically difficult to achieve.

Remote-Control T.V. Unit

➤ A "NEW LOOK" in Hanford's Chemical Processing Department is provided by a newly developed, remotely-controlled, portable television unit, which includes a camera, zoom lens, and receiver set.

The equipment is being used in CPD's separation facilities, or canyon buildings, where irradiated fuel elements from reactors are dissolved and chemically processed to separate Hanford's primary product, plutonium, from unused uranium and fission by-products.

This chemical work is performed remotely in cells located below the concrete canyon floor, and it is in these cells that the various pieces of equipment for chemical separation are located.

John Kane, Facilities Engineering-senior engineer in charge of the portable TV project, pointed out that normally, examination of this equipment has to be done through periscopes used by crane operators sitting in a protected traveling crane some 70 feet above the cells. The periscopes provide only a top view of the cells, and therefore do not allow either a close look or an "all-sides" look to help in determining reasons for equipment failure.

Now this viewing can be done through the portable TV camera which is mounted on a tilt and pan unit that moves horizontally and vertically to scan most of the area surrounding the camera. As the camera

is lowered into the cell, the television operator keeps in close contact by telephone with the crane operator to move the camera from position to position within the cell.

By controlling movement of the camera, iris opening, focus, and the zoom lens for close up or far away shots, the television operator can picture almost anything in the cell that needs to be seen. When the TV screen shows something of particular interest or importance, a "still" picture is taken of the screen with a Polaroid camera, allowing for later and more thorough study of the view.

This is not the first use of closed-circuit TV in the separation plants. A stationary television unit has been used for about four years in one of CPD's separation facilities. The large overhead traveling crane requires maintenance work from time to time, and the stationary television unit aids in this work and helps maintain control of the radiation exposure received by employees while they perform this necessary maintenance work.

A new tilt and pan lens now being made by Hanford Laboratories for the camera will provide even more adaptability, in that it will allow horizontal and vertical scanning with the lens only, rather than the entire camera. This will eliminate the bulky tilt and pan unit on which the camera is now mounted, and will make it possible to use the camera in more cramped and crowded areas.



➤ THE REMOTE-CONTROLLED portable television unit shown above provides a "new look" in the Hanford, Wash., atomic plant's Chemical Processing Department.

The equipment is used to look at areas in the chemical separation facilities where irradiated fuel elements from the atomic reactors are processed. John Kane, Facilities Engineering — senior engineer in charge of the portable TV project, demonstrates how the equipment is operated remotely as he focuses the camera on himself for a close-up view which can be seen on the receiving set.

When the unit is used in the separation facilities the camera is lowered into the radiation zone by an overhead crane and the television operator controls the camera from a distant room where he watches the picture on the receiver. Plans are being made to use the TV equipment in a number of other ways to see areas where work is being performed remotely.

Salicylic Acid

by BURTON L. HAWK

➤ IN 1859 the chemist Kolbe found a method of synthesizing salicylic acid which was both practical and inexpensive. At the time this was not a particularly earth-shaking event and, no doubt, not much importance was attached to it. But now, 100 years later, we realize that this method (still used, incidentally) paved the way for the large scale production and distribution of one of the most useful medicines ever devised by man: *aspirin*. Whether you buy aspirin in disguise, or trade your headache for an upset stomach, or use the popular blend of three proven ingredients, the importance and effectiveness of aspirin cannot be denied. It is used alone in multi-colored and various-shaped pills, and in combination with thousands of medical preparations.

Aspirin is the acetyl derivative of salicylic acid (acetyl-salicylic acid). But it is the salicylic acid which performs the desired physiological response when absorbed through the intestinal membrane. Being rather strongly acidic, it would be quite irritating if taken as is. Upon acetylation, the irritating action is reduced. The aspirin thus passes through the stomach and when it reaches the alkaline intestinal tract, hydrolysis occurs and releases the salicylic acid.

Reactions

Salicylic acid is both an acid and a phenol. Hence, reactions for the latter will also apply to salicylic acid. Prepare a solution of salicylic acid by dis-

solving a portion in water, warming if necessary as it is not very soluble in cold water. Cool, then add a few cc. of ferric chloride solution. The deep violet color characteristic of phenols is obtained. Now prepare a solution of carbolic acid (phenol) by dissolving a few crystals in a small quantity of water. (Be very careful not to allow the phenol to come in contact with your skin, as it can cause serious burns). Add a few cc. of ferric chloride solution and compare the color with that obtained with salicylic acid.

Now add dilute hydrochloric acid, drop by drop, to one of the violet solutions. Note the color gradually fades and finally disappears. To the other violet solution, add sodium hydroxide solution. Again, the color disappears.

Salicylic acid is decomposed by heat into phenol and carbon dioxide. Place a small quantity in a hard glass or Pyrex test tube. Apply heat, gradually at first, and then strongly for a minute or so. Smell *cautiously* at the mouth of the tube. You should be able to detect the odor of phenol. If you cannot, mix the salicylic acid with soda lime and heat again. In this instance, the phenol will be formed at a lower temperature.

Since salicylic acid functions as a phenol, it can be used in the formation of phthalein compounds. In a dry Pyrex test tube, place very small quantities of salicylic acid and phthalic anhydride. Add a few drops of concen-

trated sulfuric acid and carefully heat until the contents are thoroughly fused together. When cool, dissolve as much as possible in water. Add an excess of sodium hydroxide solution. The characteristic bright red coloration is obtained.

One important industrial use of salicylic acid is in the formation of azo-dyes. Dissolve 3 drops of aniline in 1 cc. of concentrated hydrochloric acid. Stir and shake gently to dissolve any hydrochloric crystals which may form. Cool the mixture by immersing the tube in a container of ice-salt mixture. Add a few drops of 20% sodium nitrite solution. Keeping the mixture cold, stir and then pour the entire contents into a cold solution of salicylic acid which has been mixed with an excess of sodium hydroxide solution. A red coloration is produced. A yellowish-brown precipitate of the azo-dye is obtained by adding dilute hydrochloric acid.

Oil of Wintergreen

The methyl ester of salicylic acid is more commonly known as oil of wintergreen. To prepare, mix 0.5 gram of salicylic acid with 1 cc. of methyl alcohol and 1 cc. of concentrated sulfuric acid. Warm the mixture gently for a short while; then pour into a beaker containing about 50 cc. of cool water. Stir. Smell cautiously and note the pleasant wintergreen odor.

Conversely, salicylic acid can be prepared by the hydrolysis of wintergreen oil. If you do not have any oil of wintergreen, you should be able to purchase a small quantity at the local drug store. Mix 3 cc. of the oil with a solution of 5 grams of sodium hydroxide in 25 cc. of water. Heat to

boiling; allow to boil for a few minutes, then cool. Add dilute sulfuric acid to the cooled solution. Salicylic acid separates out as a heavy precipitate.

Aspirin

Now, back to aspirin again. Grind three or four tablets to a fine powder in a mortar. Dissolve as much as possible in 15 cc. of water. Add ferric chloride solution. There should be no violet coloration. If there is, this indicates the presence of free salicylic acid in the aspirin (which shouldn't be there).

Aspirin is decomposed by boiling water. Grind a few more tablets to powder and place in a test tube. Add water and heat to boiling for a few minutes. Remove from the flame, then add a few cc. of ferric chloride solution. You should now obtain the violet color as boiling has released free salicylic acid.

You can prepare oil of wintergreen from aspirin. As outlined above, heat the powdered aspirin with equal quantities of methyl alcohol and concentrated sulfuric acid. Smell *cautiously* for the wintergreen odor at the mouth of the tube.

If you would like to prepare aspirin, place $2\frac{1}{2}$ grams of salicylic acid, 5 cc. of acetic anhydride and 1 cc. of concentrated sulfuric acid in a beaker. Stir the mixture thoroughly. The salicylic acid dissolves and soon crystals of aspirin begin to form. Continue to stir until no more precipitate is formed. Dilute the precipitate with 5 cc. of glacial acetic acid and filter off. Wash the product with cold water and recrystallize from boiling water.

Classroom Cloud Chamber

by DALE HENDERSON

Garden City High School, Garden City, N. Y.

Dale Henderson, at the age of 17, received an honorable mention in the 18th Science Talent Search. He hopes to follow a research career in the physical sciences.

➤ ON THE LIST of classical apparatus in physics is the Cloud Chamber. As such alone, and as a valuable and versatile demonstration piece, the cloud chamber is of great use to the physics instructor. As my high school did not have one, I decided to design, build, and design experiments for a cloud chamber for classroom use.

My first decision was to construct a diffusion chamber rather than the adiabatic expansion (Wilson) type. The Wilson chamber has the advantages of a three dimensional sensitive area, the ability to show the tracks from very active sources, and of needing no outside supply such as dry ice. The diffusion chamber, however, has the advantages of continuous operation over a long period of time, and of dependability through the absence of moving parts, seals, rubber bulbs, etc. Although not new in theory, the diffusion chamber presented many possibilities in the way of teaching innovations.

Theory of Operation

All cloud chambers work on the following principles. As a charged particle moves through the atmosphere, it ionizes some of the atoms in its path. If this atmosphere were to be super-saturated with a vapor (usually alcohol), the ions would serve

as condensation nuclei, causing the vapor to condense in fine tracks, marking the path of the particle. Cloud chambers vary in their methods of creating, conserving, and re-generating this super-saturated layer.

The diffusion chamber operates by cooling an atmosphere containing vapor through the dew point. In my chamber (and in most) this is done with dry ice. The complete system consists of: a source of methanol vapor, a cotton wick and a heating tube; a plate over which the vapor condenses; a thermal connection between plate and dry ice; a light source to illumine the condensed vapor, "columnated" to help control drifting; rings to control currents inside the chamber and help control drifting; and a field potential to sweep the area clear of all ions once they have served their purpose. The last avoids "choking" which renders the chamber inoperative.

Design and Construction

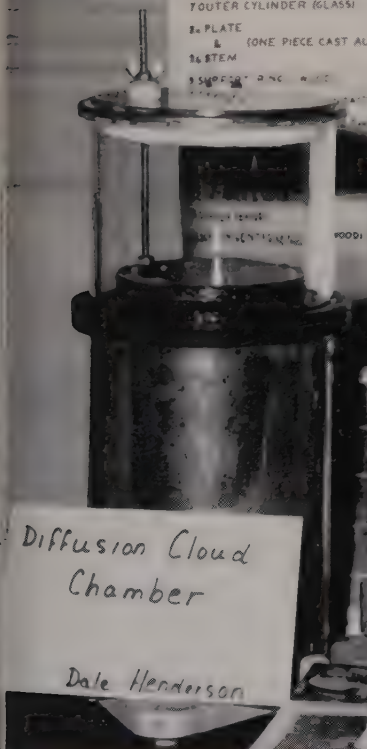
Referring to the first photograph, the components of the chamber are easily discernible. The plate and stem are a single piece of cast and machined aluminum. I did this in preference to fabrication from brass sheet and rod as the thermal connection would be better. In addition, the heavy

DIFFUSION CLOUD CHAMBER

COMPONENTS

- 1 TOP (PLATE GLASS)
- 2a HEATING TUBE (BRASS)
- 2b WICK HOLDER (BRASS)
- 3 WICK (COTTON)
- 4a
- 4b
- 5 SAMPLE
- 6 INNER CYLINDER
- 7 OUTER CYLINDER (GLASS)
- 8a PLATE
- 8b (ONE PIECE CAST ALUMINUM)
- 9 STEM
- 9a
- 9b

- 10 METHANE EQUAL RATE SYSTEM
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aluminum plate ($\frac{1}{2}$ "") will stay flat and will not be subject to bends, warps, or dents as would the sheet. I scored the surface (which is painted flat black) in a one centimeter grid to make the measurement of the tracks easy; this is especially helpful in dealing with photographs.

I put on the sliding electrical con-

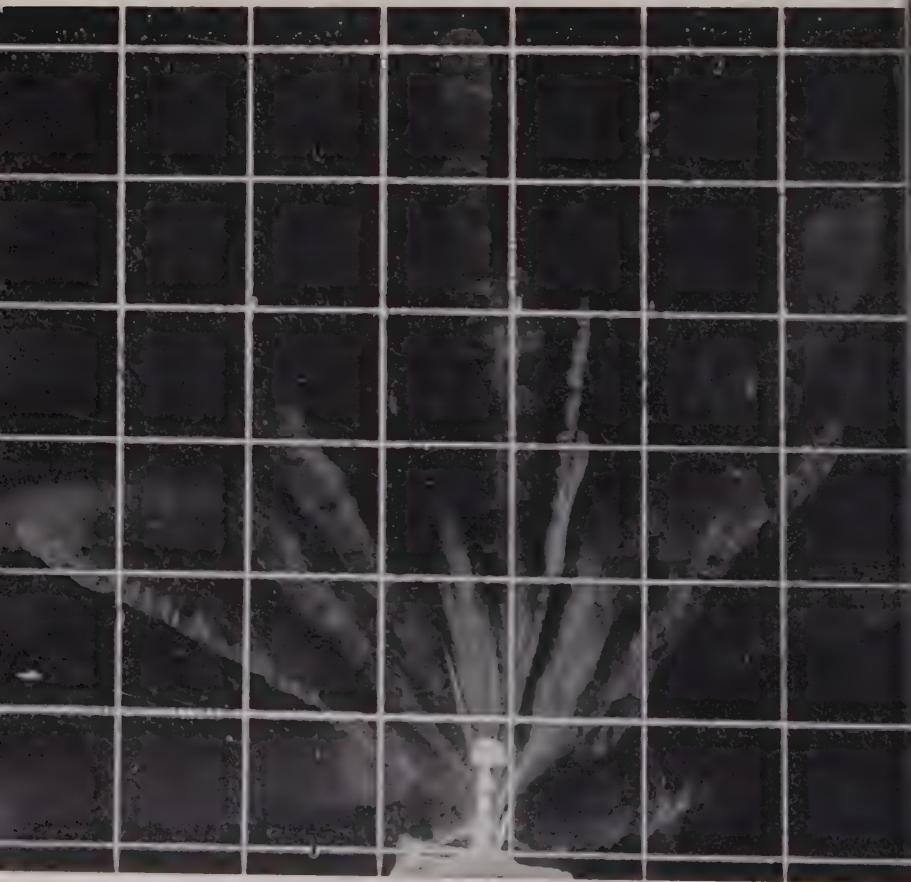
tact in preference to the earlier attached wire as it made loading much simpler. After experiencing difficulty in loading, I added the wire screen, which prevents the pieces of dry ice from blocking the path of the aluminum stem. The hot water tube at the top of the chamber was included to lessen the time required for the super-

saturated layer to form. The adjustable sample holder allows raising the sample from outside. With the sample simply placed on the plate, adjustment to the best height (for the best tracks) required disturbing the vapor, rendering the chamber inoperative for several minutes. Keeping in mind the possibility of magnetic deflection, all components of the chamber are made

of non-magnetic material, with the single exception of the tin-can which serves as container and support (No. 14 on drawing). This, however, would be easy to replace.

Operation of Chamber

Almost from the beginning I have had excellent results. After loading, the chamber begins operation in about



➤ THIS IS ONE of a number of similar photographs submitted by Mr. Henderson with his Project Report. The above was chosen as most representative.

thirty minutes, this being cut to ten through the use of the heating tube. It then operates continuously for a little over three hours, at which time the wick is dry, requiring more alcohol. No alcohol is consumed as the condensation on the plate can be re-used. At the end of this three-hour period, the dry ice is also about gone, therefore both materials are replenished at the same time.

Investigating the effect of the field voltage, I have discovered as little as 200 volts to be sufficient. The more common higher voltages (4-600 v.) serve only to make the tracks less clearly defined. Although zero voltage soon renders the chamber inoperative, the sharpest tracks are obtained by removing the potential and shorting the plate and ring (across which the potential is applied).

Referring to the second plate; the concentric rings on the surface of the plate, are magnifications of the lines left from my lathe work. The puddles are condensed methanol vapor. In general I have found the tracks sharper over the drier areas of the plate; but absorption of the alcohol on black velvet blocked operation (thermal insulation), the puddles can not be made to drain as the plate must be flat and level to avoid the heavy super-saturated layer's falling off, and removal of the liquid through a long "medicine dropper" is tedious, and disturbs the chamber for several minutes. When the plate is fairly well covered, however, the effect is not as marked. To promote this I place many small drops on the surface at the start.

The black spots on the straight-pin sources are binary numeral notation

to make identification of the source used in photographs easy and not subject to recording errors. Again, the grid lines are one centimeter apart. Included in my picture are several bent tracks and forked tracks (elastic collisions), as well as other interesting effects. All the tracks shown are α tracks from radium (?) which I took from a clock face.

Classroom Demonstrations

Here are a few of the many possible classroom uses. I have not tried the more involved ideas yet, due to the lack of materials. I have, however, included one completed experiment as an example.

Observation of particles. The tracks of α and β particles and of protons can be viewed directly in the chamber. The α and β particles can be obtained from natural radioactivity. Neutrons can be observed by some reaction resulting from neutron bombardment. The neutrons can be obtained from a radium-beryllium source.¹ Protons can be obtained from paraffin bombarded with neutrons,² this would also serve to show the neutrons.³

Cosmic ray bursts. It is possible to create a terrestrial version of cosmic ray bursts, which in turn create secondaries by bombarding lead plates with powerful particles. When one of them hits a lead atom, the shower is created.⁴ This may require an accelerator, but small accelerators are becoming more accessible.⁵

Demonstration of fission. By bombarding uranium plated (or coated) foil with neutrons, it is possible to fission uranium. The neutrons, being uncharged, do not make tracks, but

the daughter products do.⁶ Thorium, protoactinium, and plutonium have also been found to be fissionable by capture of neutrons.⁶

Elastic collisions. When α particles collide with an atom of a gas, the atom is given a velocity. Usually this is a glancing blow, both particles proceeding in different directions. This can be observed in a cloud chamber.⁷ In these "forked" tracks are visible, however they would be longer in gases such as hydrogen or helium which are lighter than air.

Transmutation. When an α particle collides with an atom of nitrogen, a particularly interesting event takes place. The nitrogen disintegrates to form an unstable isotope of fluorine which disintegrates to form oxygen and hydrogen.⁸ The reaction: ${}_2\text{He}^4 + {}_7\text{N}^{14} \rightarrow ({}_8\text{F}^{18}) \rightarrow {}_8\text{O}^{17} + {}_1\text{H}^1$. In this (Rutherford's) experiment, the α particle, the oxygen, and the proton would make tracks in the cloud chamber.

Study of particles. The cloud chamber can be used to great advantage to study the characteristics of the particles. One possible investigation is the straggling of α particles. As I have included this experiment as an example, I will not give a detailed explanation here.

FOOTNOTES

1. The equation for this is: ${}_2\text{He}^4 + {}_4\text{Be}^9 \rightarrow ({}_6\text{C}^{13}) \rightarrow {}_6\text{C}^{12} + {}_0\text{n}^1$ (high speed) White, p. 569-571.
- 2., 3. White, p. 570-571.
- 1., 2., 3. Stranathan, p. 386-388.
4. Wilson, p. 420.
5. Two communities near my own have them under construction at their high schools.
6. Semat, p. 793-795.
7. White, p. 564-567.
8. *Ibid.*, p. 567-569.

Example Experiment

Straggling of α Particles

Problem. Most α particles from any given source have a definite range. However, they are observed to vary somewhat. The purpose of this experiment was to determine the mean range frequency of each individual range track and to plot a frequency graph.

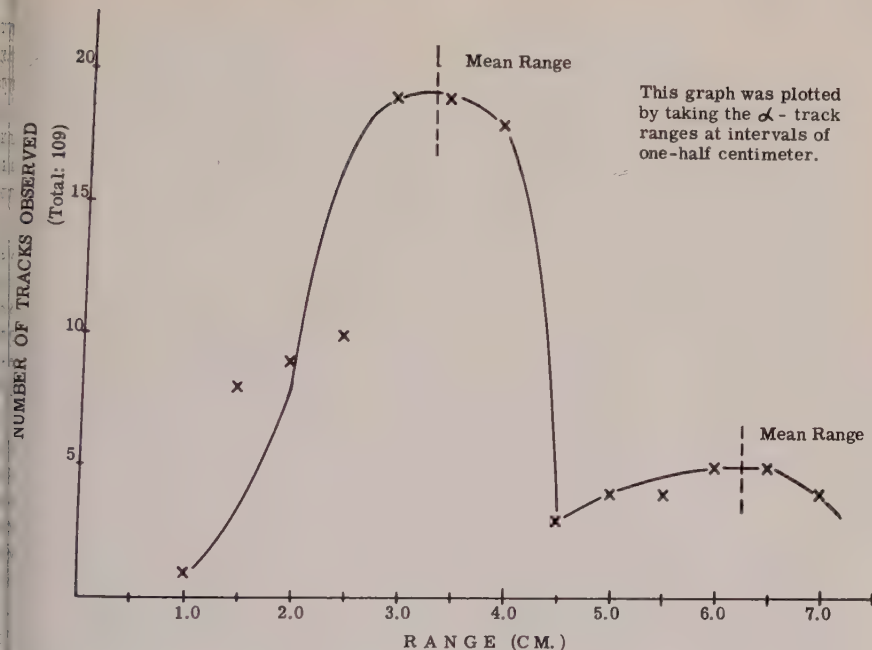
The material used was simply taken from a radium dial clock, as I have not yet obtained better sources. Therefore, there is some uncertainty as to the composition of the source. This does not hinder this actual work, but it does limit further calculations.

Method. The α tracks considered were taken from photographs of the cloud chamber. The length of the tracks was determined by multiplying the length in the picture by the inverse of the magnification factor, which is obtained by the ratio of the grid to a meter-stick. These track ranges were then put into groups by $\frac{1}{2}$ centimeter and the frequency graph plotted.

Data. The second photograph shown here is an example of those used in this experimental analysis. The table contains the track ranges of 109 tracks by pictures. They are listed in ascending order, broken into $\frac{1}{2}$ centimeter groups.

The graph. The graph shows the frequency curve, with the mean ranges marked. It will be noted that the graph indicates two groups of particles were emitted by this source, the shorter one being much more common. These mean ranges are about 3.4 cm. and 6.3 cm.

Analysis. 1. The photographs were crowded, causing some confusion as



to the tracks. It would be better to have a larger number of pictures, each with fewer tracks. I plan to try this using some sort of sequence camera in place of the press camera, which was clumsy and expensive.

2. Only 109 cases were considered. If, through more pictures, a larger number (500 to 1,000) of cases were considered, the intervals on the graph (size of range grouping) could have been smaller. This would have given more points for plotting, possibly yielding different results.

3. A standard source would have been better, as I could be sure of the composition and purity of that used.

4. This experiment did yield a result which seems to indicate that the

method of study is satisfactory and can be applied to other situations.

Conclusion and Future Work

As you note from my report, my cloud chamber is very successful as intended: as classroom apparatus. Having worked with the design, I do recommend it, and have recommended it to others, in much the same form as it now stands. A great deal of possible interesting work lies in the development of a deflection system. Electrostatic deflection is made difficult by the metal plate which is only a millimeter or two below the paths of the particles which pass through the sensitive layer. Magnetic deflection, which yields the circular rather than parabolic paths, is diffi-

cult because of the size of my chamber. I investigated construction of a Helmholtz magnet, but did not attempt it. It would be possible, but would be very large, heavy, and expensive, requiring large quantities of direct current. Small permanent magnets, placed inside the chamber, do, however, produce marked deflection. This would serve as a classroom demonstration of the principle.

Bibliography

Eich, Alfred M., "Classroom Diffusion-Type Cloud Chamber," *American Journal of Physics*, 24: 176, March, 1956.
Glasstone, Samuel, *Sourcebook on Atomic Energy*, New York, D.

Van Nostrand Company, Inc., 1958.
Semat, Henry, *Fundamentals of Physics*, New York, Rinehart & Company, Inc., 1951.

Snyder, Evan S. and John J. Heilmann, "Efficient Method for Cooling a Diffusion-Type Cloud Chamber," *American Journal of Physics*, 22: 38, January, 1954.

Stranathan, J. D., *The "Particles" of Modern Physics*, Philadelphia, The Blakiston Company, 1942.

White, Harvey E., *Classical and Modern Physics*, New York, D. Van Nostrand Company, Inc., 1940.

Wilson, Mitchell, *American Science and Invention*, New York, Simon and Schuster, 1954.

α -Track Ranges by One-Half Centimeter Groups

1.15 cm	1 @	2.79 cm	3.51 cm	4.35 cm
	1.0 cm	2.84	3.54	4.57
1.41 cm		2.88	3.58	3 @
1.49		2.96	3.60	4.5 cm
1.51	8 @	3.02	19 @	
1.56	1.5 cm	3.02	3.0 cm	
1.66		3.04	3.63	4.79 cm
1.66		3.04	3.68	4.86
1.73		3.06	3.69	4 @
1.74		3.17	3.73	5.0 cm
		3.17		5.20
1.76 cm		3.17	3.78 cm	5.29 cm
1.79		3.17	3.80	5.31
1.88	9 @	3.19	3.81	4 @
2.02	2.0 cm	3.19	3.82	5.5 cm
2.08		3.19	3.82	
2.10		3.21	3.84	5.84 cm
2.20		3.22	3.85	6.00
2.21		3.24	3.89	5 @
2.23			4.02	6.0 cm
			4.06	6.06
			4.08	6.08
			4.10	6.16
2.38 cm		3.25 cm	4.15	
2.45		3.28	4.15	6.29 cm
2.46		3.31	4.16	6.32
2.46	10 @	3.33	4.16	5 @
2.48	2.5 cm	3.34	4.17	6.5 cm
2.59		3.40	4.24	6.64
2.59		3.43		6.75
2.59		3.45		
2.59		3.48		6.80 cm
2.72		3.50		6.83
2.75		3.50		4 @
				7.0 cm
				7.14

→



A.C.S. Has New H.Q.

► THE CORNERSTONE of the new national headquarters of the American Chemical Society, at 1155 Sixteenth Street, N.W., Washington, D. C., was laid on Saturday, December 5, 1959, at 11:30 a.m. Dr. Wallace R. Brode, scientific adviser to the Department of State, a director of the society, and chairman of the building committee, was master of ceremonies.

Dr. George B. Kistiakowsky, special assistant to President Eisenhower

for science and technology, addressed a luncheon in the Mayflower Hotel after the ceremony.

The modern, eight-story structure, which will provide 80,000 square feet of office space for the Society's headquarters staff of more than 200, will be ready for occupancy early in 1960. The building will have several distinguishing features, including prefabricated exterior walls that save space and contain automatically operated

louvers to shade the windows. A 42-foot mural in stainless steel will decorate the lobby. The intricate design, made by roughening the metal and painting it, will depict atoms, molecules and other chemical entities. The artist is Mrs. Buell Mullen, internationally known creator of murals for the Library of Congress, the Naval Academy, and the office buildings of several leading corporations.

Three-quarters of the cost of the new building already has been pledged by the society's 88,000 members and by industry, according to John H. Nair of Summit, N. J., chairman of the planning committee of the building fund drive. Professor Carl S. Marvel of the University of Illinois is national chairman of the campaign, and Dr. Edward R. Weidlein, recently retired president of the Mellon Institute, Pittsburgh, is chairman of the

industrial drive. This is the first fund-raising appeal in the history of the 81-year old society, Mr. Nair pointed out.

The December 7 issue of *Chemical and Engineering News*, official organ of the American Chemical Society, was among the items to be sealed in the cornerstone at the ceremony. Also included were pictures of the old headquarters which stood on the same site and had been the Society's home from 1941 until it was razed late last year.

Those taking part in the ceremony were: Professor John C. Bailar, Jr. of the University of Illinois, president of the Society; Professor Arthur C. Cope of the Massachusetts Institute of Technology, chairman of the board, and Dr. Alden H. Emery of Washington, executive secretary.

Fluorine Compounds by Radiation

► A NEW METHOD for preparing fluorine compounds by radiation has been discovered by Dr. Paul Feng at Armour Research Foundation of Illinois Institute of Technology. Feng is supervisor of the chemical-physics section of Physics Research at ARF.

His method is especially applicable for the preparation of aromatic organic fluorine compounds which are expected to have excellent physical and chemical properties. It also may result in less expensive production of fluorine compounds and lead to the discovery of more materials.

Organic fluorine compounds, in general, are stable, non-flammable and have good temperature characteristics. However, the difficulty in preparing

them has prevented their widespread use.

In the new process a mixture of aromatic hydrocarbons and fluorocarbons is exposed to high energy radiation, such as that from a nuclear reactor, accelerator, X-rays, or gamma rays. The fluorine compounds created can be separated from other material by standard laboratory methods, for example, distillation.

Potentially, the process may be valuable in the munitions field and in the improvement of lubricating, hydraulic fluids, and plastic materials. Aromatic fluorine compounds are difficult to synthesize by direct methods because of the involved substitutions that are necessary.

Proudly Presented

Introducing New Developments and New Literature
in the Chemical Field

Fatty Acids from Crude Tall Oil Described

► A NEW BASIC technical booklet on fatty acids from crude tall oil is now available from Hercules Powder Company. The booklet discusses supply factors, describes the properties, and tells how Hercules "Pamak" fatty acids may be used in protective coatings, core oils, flotation, plasticizers, disinfectants, cleaners, detergents, floor coverings, driers, and asphalt additives.

The booklet includes sections on the origin of Pamak fatty acids, and a two-page chart which depicts industry-wide crude tall oil production and consumption from 1948.

Pamak fatty acids are produced from crude tall oil in continuous multicolumn fractional distillation plants. This process yields economically priced fatty acids of very light color, and carefully controlled uniformity of properties such as acid number and rosin content.

Technical data on the composition of Pamak fatty acids and physical properties are supplemented with tables and figures.

The section about the application of Pamak fatty acids in protective coatings includes tables showing the typical composition of important drying oil acids, comparison of alkyds from Pamak with soybean alkyd, and the performance of Pamak fatty acids in air-drying alkyds and unmodified baking alkyd finishes.

Pertinent information on the shipping, storing, and handling of the fatty acids also is in the booklet.

New Synthetic Elastic Developed

► NEWLY developed synthetic elastic threads are the remedy for sloppy socks and lazy girdles, visiting chemists were told at the American Chemical Society's Southeastern Regional Meeting.

A pulling force stronger than that of natural rubber and an unusually long life were attributed to the new fibers by Dr. Seymour Polansky.

Dr. Polansky is director of research and development of the Globe Manufacturing Company, Fall River, Mass. The new threads were developed during intensive research on synthetic polyurethane materials undertaken in his laboratory to create new elastic substances which would overcome the disadvantages of natural rubber.

Applications of the special polyurethane fibers may include sheer underclothing, lighter bathing suits, elastic tops that will last as long as a man's socks, and dry-cleanable garments with elastic threads.

Du Pont to Construct New Methylamine Plant

► A NEW PLANT to make methylamines, basic chemicals used in manufacturing agricultural chemicals, rocket propellants, textile fibers and dyes, rubber chemicals, and pharmaceuti-

cals will be built at the Du Pont Company's Belle, W. Va., site.

The new plant will more than double Du Pont's capacity for methylamines, now made at the Houston, Tex., Works, according to Clark W. Davis, general manager of the company's Industrial and Biochemicals Department.

Construction by the company's Engineering Department will begin early this year with completion expected in the first quarter of 1961. The new plant will provide jobs for about 18 employees at Belle, with construction requiring an average of 90 men monthly.

Mr. Davis said Belle was a logical choice for methylamine expansion since it already produces the raw materials, ammonia and methanol. The new plant at Belle will make possible better service for customers in eastern markets at reduced freight costs.

Du Pont discovered a low-cost process for methylamines by direct synthesis from methanol and ammonia in 1930 as a result of research work at the company's Experimental Station by a group headed by Crawford H. Greenewalt, who is now president of the company. Other research chemists in the group included Dale F. Babcock, now director of the reactor engineering section of the company's Atomic Energy Division, and David H. Dawson, now a Du Pont vice president and member of the Executive Committee.

Dimethylamine (DMA) is a liquefied gas used in the manufacture of liquid missile fuel, fungicides, 2,4-D herbicides, pharmaceuticals, rubber chemicals, antioxidants, and solvents.

In addition to DMA, the plant will make the methylamine derivatives dimethylformamide (DMF) and dimethylacetamide (DMAC). DMF is used principally in the manufacture of "Orlon" acrylic fiber and as a solvent for vinyl resins in lacquers, films and printing inks. DMAC is a new polar solvent which became available in commercial quantities recently. It is expected to find use as a polymer and crystallization solvent and as a chemical reaction catalyst and medium.

Polymer Research Center To be Established

► THE CAMILLE and Henry Dreyfus Foundation has made a grant of \$2,500,000 for the establishment of an international center for polymer chemistry at North Carolina's new Research Triangle Institute.

The new research center will be known as the Camille Dreyfus Laboratory, in memory of Dr. Camille Dreyfus who was the founder and first president of Celanese Corporation of America. Polymer chemistry was an integral part of many of Dr. Dreyfus' now world-famous scientific achievements in the field of cellulosic chemistry — an area of science which gave birth to both the man-made fibers and plastics industries.

Although owned by Research Triangle Institute, and operated as an integral part of the Institute's research activities, the Camille Dreyfus Laboratory will have its own building, research program, staff and facilities.

It will be located on Research Triangle Institute's 200-acre campus in the 4,500-acre Research Triangle Park. The Park, now being developed as a

center for research laboratories, is within a 15-mile radius of the University of North Carolina, Duke University and North Carolina State College.

Construction work on the proposed \$700,000 laboratory is expected to start in 1960. The building, of contemporary architectural design, will have 20,000 square feet of floor space and will include a 200-seat auditorium for use by regional and national scientific groups.

The staff will conduct basic investigations in the chemistry and physics of polymers, including cellulose, and their derivatives, with the objective of expanding the general fund of knowledge in this field. Results of such basic research will be published as papers of the Camille Dreyfus Laboratory of the Research Triangle Institute.

In addition to its fundamental research work, the Dreyfus Laboratory will be of sufficient size to accommodate some applied research activities. It is anticipated that the additional staff required for such work would be supported by applied research contracts from government and industrial sources.

The Camille and Henry Dreyfus Foundation is a non-profit organization established to advance the science of chemistry, chemical engineering and related sciences in order to improve human relations and conditions throughout the world.

Booklet on Steel Elements Available

► TO BRING to the students of America an awareness of the increasing use of alloy steels in objects used in every day life and their importance in this

age of space missiles, supersonic aircraft, nuclear reactors and other wonders undreamed of fifteen years ago, U. S. Steel has prepared a 16-page booklet entitled, "Principal Alloying Elements in Steel."

The booklet, written for high school and college freshmen chemistry students, is divided into seven major sections. The first describes carbon steel, alloy steels and ferroalloys. A world map shows principal ore deposits of alloying elements. This section is followed by general information on each of the 12 principal alloying elements, the form in which it is used, its effects on the properties of steel and typical products made of such steels.

The ensuing section details the mechanical, magnetic and chemical properties of steel and describes widely used tests to determine these properties.

Sixteen representative alloy and stainless steels are then compared with carbon steel as to properties such as hardness, ductility, elasticity and breaking strength. Following a glossary and table of constants for iron, carbon and the twelve alloying elements, the booklet concludes with a word game, quiz questions and answers, and a problem in mathematics.

The booklet is available without charge upon request. For this and other teaching aids, write to Public Relations Department, U. S. Steel, 71 Broadway - Room 1800, New York 6, New York.

"Dry" Phosphatizing Process for Metals

► A NEW "dry" phosphatizing process, which eliminates water solutions

and applies protective phosphate coatings to metal parts at savings in equipment investment, floor space and operating costs, was exhibited at the recent National Metal Exposition and Congress by the Du Pont Electrochemicals Department.

The phosphatizing process, linking vapor degreasing to spray-in-vapor painting in a complete metal finishing system based on "Triclone" trichlorethylene, was shown operating in a plant-scale unit at the company exhibit. This compact machine was designed and fabricated by G. S. Blakeslee & Company, Chicago, which is cooperating in the development.

In the new process, metal parts are given a phosphate coating by dipping or spraying with a trichlorethylene-based phosphatizing solution maintained at its boiling point (188 degrees Fahrenheit). After phosphatizing, as the parts emerge from the trichlorethylene vapor zone, the solvent completely evaporates leaving parts dry and ready for immediate painting.

The coating, as formed on steel, is a strongly adherent form of iron phosphate which provides an excellent paint base. Coating weights from 40 mg./sq. ft. to over 200 mg./sq. ft. can be achieved in from one-half to three minutes' time. Phosphate coatings can also be produced on other metals such as aluminum, magnesium and zinc.

This new process, which will be commercially available in mid-1960, is now operating on a field trial basis at several locations.

Folder Discusses Pharmaceutical Problems

➤ A NEW 4-page folder, titled "X-ray

Analysis of Pharmaceuticals", is available from Philips Electronic Instruments, 750 South Fulton Avenue, Mount Vernon, New York.

Illustrated with photos, the text describes work with X-rays reported by Parke-Davis & Company in solving many problems.

Investigations involve zinc content of rubber closures, iron content of clays, selenium in steroid preparations, merthiolate in protein mixtures, organic bromine in cough syrup, hyoscine in motion sickness medicine, hydrogenation and high pressure reactions on catalysts, iron oxide in vitamins, and inert materials in antibiotics.

Aerosol Reagents For Chromatography

➤ SCHUCC Scientific, announces a new development for the laboratory: Volutec Laboratory Sprays (Pat. Pending), a completely new line of reagents.

The line includes a complete range of reagents for spot development on chromatographic paper: ninhydrin in acetone and butanol, Isatin, Bromcresol Green, Ferric Chloride, p-Anisidine Hydrochloride, and Aniline Hydrogen Phthalate. They come packed in a free carrying and storage rack.

Constant product stability is maintained because reagents are always protected from light, air and contamination. Each standardized solution provides a fine, uniform spray and does away with constant preparation of new material, thus eliminating time-consuming chores.

Write to Schuco Scientific, a division of Schueler & Company, 75 Cliff Street, New York 38, N. Y., for complete information and price list.

Data on Pyridines And Piperazines

➤ A NEW 20-page booklet, describing the properties and uses of pyridines and piperazines, has been published by Union Carbide Chemicals Company, Division of Union Carbide Corporation.

The booklet contains extensive data on five pyridines and six piperazines, including physical properties, constant-boiling mixtures, solubilities, shipping data, storage and handling, specification limits, test methods and physiological properties. It also includes a detailed bibliography and reference section.

The pyridines have been of particular interest in the manufacture of pharmaceuticals since the structure appears so frequently in the chemistry of living matter. Increased availability from petro-chemical sources has encouraged other uses, including surfactants, monomers, and chemical intermediates.

Piperazines are used as intermediates for anthelmintics, motion sickness remedies, tranquilizers, and other central nervous system drugs. Large-scale availability of the piperazines has led to their use for surfactants, polymers, and dyeing assistants.

New Transistorized Scintillation Detector

➤ A NEW transistorized scintillation detector is now available from Tracerlab. The new unit, the P-20D, has been specifically designed for both clinical and research laboratory applications such as gamma spectrometry, gross gamma assay; and alpha and beta counting. Any one of eleven different detection heads may be used

with the main unit. Detector heads are available with Honeycone and flat field collimators for clinical use, well-type gamma and beta crystals for counting liquid samples, and alpha, beta, gamma and gamma spectrometry crystals for sample counting. Exceptional versatility is obtained since all detection heads are interchangeable.

The main unit to which the detection heads are attached consists of a photomultiplier tube, a transistorized variable gain pulse amplifier, and a high-voltage corona regulator. The corona regulator aids in maintaining a constant voltage on the photomultiplier tube and as a result, a long (more than 150V), flat (less than 5% slope/100 volts), plateau is obtained when using the detector for normal gross assaying. An externally mounted switch bypasses the amplifier and corona regulator when the unit is used with a linear amplifier for gamma spectrometry. The P-20D employs the new RCA6655A photomultiplier tube. This tube was specifically designed for scintillation spectrometry and provides a higher degree resolution than has hitherto been possible.

Radiocarbon Compounds Listed

➤ A NEW 46-page illustrated catalog lists the Carbon-14 Labeled Compounds manufactured by Research Specialties Co. It gives prices, discounts, ordering and licensing information, purity methods, and other pertinent data. Many license exempt packages are offered and there is a special list of hydrocarbons. Free copies are available on request from Research Specialties Co., Richmond, California.

World's Largest Blender Constructed

➤ USING ITS patented Twin Shell design, The Patterson-Kelley Co., Inc., has manufactured a blender capable of uniformly blending at one time enough plastic powder to fill two railroad hopper cars.

Designed for a working capacity of 1700 cubic feet, the 30-ton Twin Shell blender consists of two cylinders cut at right angles and joined to form a V-shaped design. The gigantic blender, when fully charged, rotates on its axis at 4 rpm to create the divergent flow pattern, which results in effective blending.

Although Twin Shell blending units are often charged through openings at the top of the two cylinders, the big blender will be charged and discharged through an outlet valve at the apex of the V-shaped shells. The valve is air-operated for remote control.

The shells of the huge blender, each 11 feet in diameter and more than 22 feet high, are constructed of solid $\frac{1}{2}$ inch stainless steel. Plate layout prior to forming the twin cylinders or shells covered an area equal to one-quarter of a football field.

New Bulletin Issued On PVP/VA Copolymers

➤ AN EXPANDED and comprehensive bulletin on new types of commercially available vinylpyrrolidone/vinyl acetate copolymers and their numerous applications has just been issued by Antara Chemicals, sales division of General Aniline & Film Corporation. These materials were first introduced as 50 per cent ethanol solutions. They are now available in various physical

forms as well as in several monomer ratios. Solid, emulsion and solution types now provide specific materials suitable for diverse processing conditions and product requirements, and for use in aqueous as well as organic solvent or aerosol systems.

This two-color, 20-page publication outlines recently developed uses of these acetylene-derived chemicals. Technical data are presented in charts, and practical formulations are given for use in adhesives, hair-grooming agents, protective films, shoe polish, plant spray, decorative sprays, and anti-tarnish coatings.

PVP/VA copolymers exhibit distinctive adhesive and film-forming properties with specific affinity to smooth surfaces, such as wood, glass, paper, metal and hair. Films formed by individual members of the group feature adhesiveness, transparency, luster, hardness, and water rewetability, and do not require volatile solvents for removal.

The new bulletin also describes stability factors, viscosity ratings, compatibility and physiological data. A copy of Bulletin AP-88 Rev. is available by writing to Antara Chemicals, General Aniline & Film Corporation, 435 Hudson Street, New York 14, New York.

Plastic Apparatus Catalog

➤ A COMPLETE range of laboratory apparatus in a number of different plastics is described in a new catalog issued by Rascher and Betgold, Inc., of Chicago.

Also included is a chart showing the resistance of three "nalgene" plastics to most of the common laboratory reagents.

Plant Handling "Hot" Materials

► THE LARGEST privately-owned facility in the world for remote examination of radioactive materials is now in operation in the Santa Susana Mountains near Los Angeles, it has been announced by Atomics International, a division of North American Aviation, Inc.

The facility, known as the Components Development Hot Cell and located at the company's 290-acre nuclear field laboratory, is used for development of experimental atomic reactor fuel elements and for testing various irradiated reactor materials and components. It is one of the most complex installations of its type.

Fuel elements from the Sodium Reactor Experiment (SRE) and the Organic Moderated Reactor Experiment (OMRE) are examined in the facility. The SRE and OMRE are experimental nuclear power projects conducted by Atomics International for the Atomic Energy Commission.

Examination of irradiated test fuel elements also is conducted for the sodium-graphite reactor Atomics International is building for a 75,000 kilowatt nuclear power plant at Halsey, Nebraska. The Nebraska plant, part of the AEC's power reactor demonstration program, will be operated by the Consumers Public Power District of Nebraska when completed in 1962.

The 17,799 square foot hot cell building has four large, shielded compartments for handling radioactive materials, with related operating and service galleries, decontamination areas and equipment maintenance and storage space. Laboratories, control areas, a mock-up equipment develop-

ment shop and administrative offices are provided. Included is Atomic Energy Commission equipment for work on Commission projects.

An unusual feature of the facility is the ability to maintain an inert atmosphere of less than one percent oxygen in each operating cell.

Shielding is provided by 42-inch thick heavy concrete walls which separate the cells from the operating gallery. Forty-ton cast iron doors and shielded windows made of special glass with a lead content of more than 50 percent give additional protection.

The cells are arranged in rectangular blocks and are interconnected by transfer drawers. Sliding drawers between the cells and decontamination areas allow material and equipment to be moved to each area. Interlocks provide for the transfer of fuel elements without opening cell doors.

There are nine operating stations, each equipped with a shielded window and a pair of mechanical "arms," called manipulators. Remotely controlled by operators, the manipulators handle radioactive materials in the cells. They are capable of threading a needle or of lifting up to 750 pounds.

Sodium Dispersions Available

► ACTON Laboratories, of Newark, N. J., have announced that they are offering Sodium Dispersions as two standard products. These are:

Sodium Naphthalene Dispersion, Crushed Solids 50% Sodium in Mineral Oil.

The nature of these products prohibits sampling, but orders of one pound lots are accepted.

Decimal and Metric System Discussed

➤ WHETHER industry should abandon the inch and adopt the centimeter in industry is being debated. It is being urged that the other units of the metric system widely used abroad and in research laboratories in this country should be used more universally.

Although already legal and the prime standard of measurements, the metric system is still not generally used.

Discussions at the American Association for the Advancement of Science showed that some large industries, notably in pharmaceuticals and astronautics favor converting to the metric system. Other areas, notably steel fabricating, automobile manufacturing and gauge manufacturing are opposed.

Vice Admiral G. F. Hussey, Jr., managing director, American Standards Association, New York, reported that the discussion tended to support opposition to the conversion.

Most industries that favor the metric system, like pharmaceutical manufacturers, are closely allied to research methods. For instance, Parke, Davis and Company, Detroit, has converted to the metric system with standardization of all weighing and measuring equipment, reduced chances of error, less maintenance, simpler inventory, and fully electronic data processing.

On the other hand, metal industries, auto makers and similar firms cite in opposing the metric system the cost of the physical changes in drawings and equipment that would be necessary and the loss of skills on the part of designers and workmen accustomed to visualizing in inch dimensions.

Expression of fractions of pounds, pints, etc., in decimals, not in ounces, etc., was favored by Dr. Colston B. Warne, professor of economics, Amherst College, and president, Consumers Union of U. S. Where 3 lb., 21½ oz. now appears on a "giant size" detergent package, it would read 3.16 lb. This would make it easier for a customer to do his arithmetic in choosing the best buys.

The eventual goal in Dr. Warne's opinion would be a switch to the metric system of units, but a step in that direction would be to do what one brand of baby food does, when its label states both kinds of units: 3½ oz., 99 grams.

Dr. Warne suggested that some manufacturers may produce varied and peculiar weights of packages merely to confuse the buyers. On one grocery shelf seven weight packages ranging from 2 lb. 5½ oz. to 3 lb. 8½ oz. were found all labeled "giant size."

Answers to CHEMISTRY QUIZ on Page 11.

A - 2; B - 4; C - 3; D - 1; E - 2.

Cheap Chemicals from New Reactor

► COMMERCIAL chemical products, such as ethylene glycol, can be made in a new type nuclear reactor at a most competitive with conventional chemical manufacture.

Hercules Powder Company, developer of the new reactor design, says that it could make possible the first peacetime application of atomic energy capable of competing with standard chemical manufacturing techniques.

Nuclear reactors have been used to produce electrical or thermal power, but at a cost in excess of conventional methods. Chemical materials have also been made by radiation in a reactor, but the cost, using existing reactor designs, has been prohibitive.

Hercules research has been directed toward utilization of the fragment re-

coil energy of nuclear fission, which constitutes about 80% of the total fission energy. Normally, this energy is absorbed in the fissionable fuel and its container. In special types of nuclear reactors with finely divided fuel, however, this energy is available for chemical transformation. After the chemical synthesis, most of the energy is still available for electrical or thermal power generation.

The company believes the reaction is applicable to a wide range of organic chemicals. In general, however, it was found that chemicals of lower molecular weight tend to give higher yields of easily separable products.

For example, yields of over 65% of ethylene glycol have been obtained from methanol using the Hercules process.

New Antibiotic Drug

► A NEW DRUG, which appears to wipe out many of the infections resisting penicillin, has been discovered by British scientists. It is called cephalosporin C.

Its isolation by doctors working at Oxford and in Somerset marks a new breakthrough in the antibiotic field. In laboratory tests it has killed many of the organisms, notably staphylococci, which have recently developed immunity to penicillin. The rapid build-up of this resistance has been alarming doctors everywhere and has led to a sharp rise in hospital infections.

The drug is closely related to the penicillin family but has a different

chemical structure. It was first discovered in sewage effluent in Sardinia, the Italian island in the Mediterranean, but is now being produced synthetically in England.

The basic work on the new drug has been done by scientists under Prof. Sir Howard Florey and Dr. E. P. Abraham, of the pathology and bacteriology department of Oxford University, and by the Medical Research Council's research station at Clevedon, Somerset, under B. K. Kelly.

"The cephalosporins have been known for several years," said J. C. Duckworth, who recently succeeded

Lord Halsbury as managing director of the British Government's National Research Development Corporation.

"Many antibiotics have been isolated from the general group and the C one is believed to have the most possibilities. The development of the new drug will not be held up by any shortage of cash," he promised.

Tests on animals have proved completely successful and similar tests on human beings are to start almost once, Mr. Duckworth said. Already two companies, Glaxo Limited and the Distiller Company, are investigating the possibilities of large-scale commercial production of the new antibiotic.

Army Works on "Muscle Engine"

➤ A CRUDE forerunner of what some day may be a "muscle engine" has emerged from basic research at the U. S. Army's Frankford Arsenal.

The muscle in this engine consists of an organic film that contracts when it comes in contact with an acid, and expands when it comes in contact with an alkali.

In a demonstration, the contracting film was made to lift and lower a cardboard arm resembling the arm of a man. In other demonstrations, the film lifted small weights.

The same chemicals were used over and over in demonstrations to make the muscle engine work, according to Dr. Henry Gisser. Dr. Gisser is associated in the project with James J. Mikula and Joseph Weisburg.

Dr. Gisser said it is far too early to predict whether some day Army tanks may be chemically powered by muscle engines.

He said the project is aimed at finding a way to change chemical energy directly into mechanical energy without going through a heat cycle. The heat cycle imposes a limit on efficiency that can be obtained, he said. If the heat cycle can be eliminated, the efficiency for converting chemical energy into mechanical energy might be raised.

Officially called "synthesis of poly electrolytes for contractile films," the research has already proved so successful that further funds are to be spent on it in 1960.

Development of this muscle-engine idea comes within the scope of the Army's provision for "novel engineering projects." Under Army policy limited funds are provided for preliminary work on promising novel technical ideas in any area of ordnance engineering. In this case, early research showed that the idea had merit.

New Light on DNA and RNA

➤ A UNIFIED theory of heredity and virus infection may be a step closer because of tests indicating that two essential life chemicals differ more than previously believed.

The two chemicals are the nucleic acids RNA (ribose nucleic acid) which controls cell protein production and DNA (deoxyribose nucleic acid) the material the genes are made of.

Dr. Saul Kit, a biochemist at the University of Texas M. D. Anderson Hospital, has found evidence that tumor cell RNA is composed of single-stranded molecules, while DNA is two-stranded.

Dr. Kit's analyses of nucleic acids of normal and cancer cells from humans and animals tend to confirm the previously held belief that DNA is two-stranded. Heating and cooling DNA splits the hydrogen bonds that bind the two twined strands together.

However, evidence indicates that RNA is composed of only a single segmented strand, because heating does not split either the whole RNA molecule or its separate segments.

The scientist now believes that gene DNA serves as a frame on which RNA is manufactured. The RNA then migrates outside the nucleus, takes up residence in the cell's cytoplasm and there produces the enzymes and other proteins that govern the size, shape, chemical function and behavior of the cell.

RNA, he believes, may be the mechanism by which genes transmit the information that defines the inherited traits of the cell. The theory may help to explain how viruses composed of RNA and viruses composed of DNA could have similar effects on the cell.

Gallium Phosphide Prepared

➤ Two CHEMICAL elements, both of which will melt in the sun on a hot day, have been combined to produce a material capable of withstanding temperatures up to 1,500 degrees Fahrenheit.

Gallium phosphide, a yellow compound resembling ground glass, has been prepared from gallium, a rare silvery metal, costing about \$1,500 a pound, and phosphorus, used in matches, by the U. S. Army Signal Corps Research and Development Division, Fort Monmouth, N. J.

The material may be used in build-

ing solar-cell power plants for space stations, and tiny rugged electronic parts for missiles, satellites and space probes of the future.

So far the Army Signal Corps has built an electronic diode of gallium phosphide which has withstood temperatures seven times higher than those withstood by the now-used silicon and germanium.

Further research will be done to determine the properties of the material before it is passed on to the Army Signal Corps equipment development engineers.

Russian Believes Moon's Surface is Slag

➤ A RUSSIAN astronomer is convinced the moon's surface is composed of a porous material resembling slag from volcanoes but resulting when the rocks of the lunar crust are smashed by meteors.

Prof. N. N. Sytinskaya of the Main Astronomical Observatory of the U.S.S.R. Academy of Sciences reported that his conclusion is based on "photometric, colorimetric and polarimetric investigations of the moon."

It was made before the recent Russian moon shots, one of which landed on the moon and the other of which circled the moon to take photographs of the previously unseen side.

Prof. Sytinskaya said that the lunar atmosphere, if it exists at all, is so extremely thin that even very tiny micrometeorites reach the surface with velocities sufficiently high to cause explosions. The micrometeorites blast the surface at the rate of two and a half each square inch each minute. Therefore, he concluded, the action of micrometeorites alone is sufficient

for the "formation on the lunar surface of a continuous film of modified material during a very short time."

The resulting slag material is dark-colored due to the breakdown of silicates and the formation of black iron oxides, he reported in "Soviet Astronomy," a translation of the Russian publication, "Astronomical Journal," issued by the American Institute of Physics.

The lunar maria, or seas, Prof. Sytinskaya said, are darker because the original rocks of the maria contain a higher proportion of iron.

Computers in Chemistry

► COMPUTERS are among the most effective classroom and laboratory demonstration aids, the annual meeting of the American Institute of Chemical Engineers was told.

"The analogue computer has shown itself to be an excellent teaching aid in presenting the dynamic behavior of physical and chemical systems," said Theodore J. Williams and Verlin A. Lauher of the Monsanto Chemical Company, St. Louis.

They went on to explain how it

can be wired to simulate, or become electronic models of, many physical and physical-chemical systems, so that the model is more vivid than the experiment itself.

J. W. Tierney of Remington Rand Univac, St. Paul, Minn., said the digital computer "has become an important aid in chemical engineering calculation." He stressed that students of engineering should be taught the proper use of computers along with the other calculation tools available.

Plastic Rockets May Fly Into Space

► PLASTIC rocket engines can push satellite payloads deep into space.

Advantages of glass-reinforced plastic as a material for the fabrication of rocket motors were described to the American Rocket Society by three Hercules Powder Company engineers. A. H. Kitzmiller, Jr., C. C. DeHaven and R. E. Young reported that the material has a strength-to-weight ratio better than aluminum, alloy steel

and titanium. It also has low thermal conductivity, is easy to fabricate, has high corrosion resistance and a "low material cost."

Called Spirallo, the material consists of multiple strands of continuous glass fibers drawn from spools and fed through an epoxy resin cup before being wound on a mandrel. After winding is complete, the rocket casing is cured.

Plastic Doubles as Rubber

► A NEW MATERIAL that can be molded, melted, and milled like a plastic, but is also rubbery, making it suitable for use in shoe soles, floor tiles, and coverings for cables and golf balls, was reported to the Southwest Regional meeting of the American Chemical Society.

The material is a polybutadiene, that is it consists of long chains built up of molecules of butadiene, a chemical closely allied to the building blocks of natural rubber.

The man-made rubber was reported

by J. R. Haws of the Phillips Petroleum Company, Bartlesville, Okla., to be not as elastic as natural rubber, but equal in hardness and resilience. It may also, like natural rubber, be vulcanized to give substances varying from a soft rubber to hard inelastic materials.

The material is called high-trans polybutadiene, according to Mr. Haws, who also explained that the "high-trans" implied that the atoms making up the chain were arranged in a definite repetitive order.

Chromite Cuts Smog Exhausts

► CHROMITE compounds have been found to cut up to 90% the amount of nitric oxide expelled by automobile exhausts, and scientists at the Franklin Institute Laboratories, Philadelphia, believe this discovery may open a new avenue toward combating eye-smarting smog.

Use of zinc-copper chromite, iron chromite, barium-promoted copper chromite and chromium-promoted iron oxide have been found efficient in helping carbon monoxide, already present in the exhaust, to scrub out nitric oxides sent into the air.

Nitrogen oxides, along with unburned hydrocarbons, have been blamed for contributing to smog conditions in auto-packed Los Angeles. When enough oxygen is present, chromites induce oxidation of hydrocarbons and carbon monoxide and without special air pumps.

Director Dr. Nicol H. Smith said more experiments are needed to determine whether chromites can withstand the poisoning effects from lead in exhaust gases. If so, they "promise to be an economical means of reducing photochemical smog."

Fusion Causes Supernovas

► FUSION EXPLOSIONS, such as man has made on earth, but on a scale many millions of times larger, are responsible for the stars known as supernovas, which suddenly blaze to

brilliances hundreds of thousands times their normal brightness.

This theory on fusion chain reactions to account for supernovas was reported to the American Institute of

Physics by Dr. Michal Gryzinski of the Institute of Nuclear Research, Polish Academy of Science, Warsaw. He suggests that the conditions suitable to a strong concentration of helium three, the fusion material, exist only for a relatively small number of stars.

The helium three is formed when protons react in the hydrogen-burning cycle by which stars are stoked. If the star's temperature does not exceed

about five million degrees absolute then a sufficient amount of helium could be produced in about five billion years to give the critical density at which the fusion chain reaction developed.

The nuclear energy released in the outburst is much greater than the star's potential energy, so it is completely destroyed, Dr. Gryzinski reports.

Effects of Sun's Heat on Metals

➤ RADIATION from the sun can be man's enemy, or an almost unlimited source of energy, if controlled and harnessed.

The harnessing calls for the right equipment, and two University of California engineering professors are now studying and testing different materials for making the equipment.

Under a \$51,000 grant by the National Science Foundation, Joseph T. Gier of the Los Angeles campus and Robert V. Dunkle of the Berkeley campus are beginning a two-year investigation of the spectral character-

istics of metals which determine how much of the sun's heat a metal will absorb, transmit or reject.

The two engineers will test existing materials, but also try to develop special metal coatings and films for solar energy equipment.

Future applications may range from spaceship hulls which will protect astronauts from boiling heat and freezing cold, to down-to-earth solar cooling equipment, solar stills for making fresh water from salt water, and batteries to convert the sun's energy into electrical power.

Device Measures Fast Reactions

➤ CHEMICAL reactions that occur in 1/10,000th of a second can be detected and analyzed with the aid of an electronic instrument known as a Time-of-Flight Mass Spectrometer. Built by Bendix Aviation Corporation, the instrument derives its tremendous speed from instantaneous identification of vaporized gases, liquids and solids revealed by their respective molecular masses.

Ionized molecules of the elements being analyzed are pulsed like radio signals from one end of the tube to the other. Their speed, or "time of flight," is measured electronically and appears as a wave pattern on a picture tube. Thus, the instrument can analyze an almost instantaneous sequence of chemical reactions such as those that take place in flames and explosions.

On the Back Cover

► THE OLD DISAPPEARING rope trick has a new twist. You sell propylene, a gas by-product of an oil refinery, and when you get it back it's a revolutionary new rope, light enough to float yet strong enough to hold a tanker in port against hurricane-force winds.

This rope is called polypropylene rope. Sinclair Petrochemicals, Inc., a subsidiary of Sinclair Oil Corporation, sells the propylene to Hercules Powder Company who converts it into polypropylene. This is in turn manufactured into rope by American Manufacturing Company, and to make the cycle complete, Sinclair has installed the rope on two of its tankers where the rope has exceeded all expectations.

Late last fall, shortly after the polypropylene rope was installed on the tanker, "S. S. Sinclair Superflame," the ship was caught in a southern port by hurricane-force winds. All of the hawsers except the one made of polypropylene were cast off. Two tugs were unable to move the tanker close to the dock, but the polypropylene hawser, seven inches in circumference, safely withstood the force of the winds and held the tanker fast to the dock.

Sinclair's Marine Department officials, pleased at the test results, have been closely examining the rope at

each docking, and report that the rope does not pick up any water or freeze like conventional ropes and is considerably easier to handle. Whereas in the past it took two or three men to handle manila rope with similar strength on the dock, one man now does the job with ease.

Other advantages of the rope, say American Manufacturing Company officials, is that it has superior gripping power because its surface is not slippery, it resists kinking, and has excellent resistance to rotting from solvents, greases, oils, and water.

Polypropylene, made commercially in the country only by Hercules, is a new plastic material rapidly coming to the forefront as a material for scores of plastic items. It is the lightest of all commercial plastics, and this advantage is expected to be of interest in rope applications.

A polypropylene hawser that is seven inches in circumference weighs approximately 100 pounds per one hundred feet. Manila rope of equivalent strength measures nine inches and weighs nearly 250 pounds per hundred feet when new and picks up considerable additional weight when wet. The new rope is the lightest of any commercially available. It is also available in colors.

Colliding Galaxies Cause Radiation

► GALAXIES in collision cause nuclear reactions that could be detected from satellites circling high above the earth's atmosphere.

Such galactic collisions could be

spotted at distances far beyond the limit of present optical telescopes, Dr. S. N. Milford of St. John's University, Queens, New York, reported here.

Galaxies are giant aggregates of bil-

lions of stars, such as the Milky Way in which the sun and its planets, including earth, are located. When galaxies collide, the stars in them are so far apart that they do not touch or even come close. However, the very sparse hydrogen gas in the interstellar space within the galaxies becomes violently agitated.

Dr. Milford has calculated that the nuclear reactions in the interstellar gases are negligible during the first stages of collision.

At later stages, the nuclear reactions

take place, resulting in the production of gamma rays.

Dr. Milford suggests measuring the gamma rays above the earth's atmosphere.

Once detected, he reported, discrete gamma rays would give information about the temperature and composition of the gas.

These gamma rays would also provide another test of how far and how fast the universe is expanding, Dr. Milford states in the *Astrophysical Journal* (Sept.).

Fallout Drops Sooner than Believed

► **FALLOUT** measurements taken over Norway indicate that radioactive particles from nuclear tests remain in the stratosphere only about half a year, instead of five to ten years as scientists had previously estimated.

This would mean that the worst fallout from the most recent nuclear bomb test (Nov. 3, 1958), by Russia, has already taken place.

These findings were made by the Norwegian Defense Research Institute and were based on systematic measurements reaching up to 40,000 feet in altitude.

These important conclusions have not yet been officially published, it was learned at the Norwegian Embassy in this country.

The stratosphere, the upper layer of the atmosphere, begins at anywhere from 25,000 feet over the poles to 55,000 feet over the equator. Samples taken from altitudes up to 40,000 feet over Norway were thus well into the stratosphere.

The measurements were made exclusively over Norwegian territory in cooperation with the Norwegian Meteorological Institute and the Air Force. They showed that radioactivity near the ground increased steadily until last May, although no nuclear bomb had been detonated for a half year.

During the following months, however, radioactivity levels have dropped just as steadily. Peak radioactivity therefore occurred six months after the last detonation.

Not only should the worst fallout period be over, research director Torleif P. Hvinden reported, but radioactivity should decrease to an unmeasurable level within the next several years if there are no further bomb tests.

The reason it has now become possible to obtain results contrary to previous belief is largely because measurements have now been made during a time span free of nuclear detonations.

Book Condensations

ADVANCES IN CARBOHYDRATE CHEMISTRY, Vol. 14 — Melville L. Wolfrom and R. Stuart Tipson, Eds. — *Academic*, 526 p., \$15. Covers the Mailard reaction, the cyclitols, amino sugars, pyrimidine nucleosides and hemicelluloses.

ELECTROLYTIC MANUFACTURE OF CHEMICALS FROM SALT — D. W. F. Hardie — *Oxford Univ. Press*, 74 p., illus., \$1.20. British textbook.

THE MANUFACTURE OF SULFURIC ACID — Werner W. Duecker, James R. West, Eds. — *Reinhold*, 515 p., illus., \$12.50. Twenty-four specialists treat all aspects of the modern sulfur burning contact plant and its modifications for other raw materials.

AUTOMATIC TITRATORS — J. P. Phillips — *Academic*, 225 p., illus., \$6. On the effects of automation on volumetric analysis.

CHEMISTRY OF NUCLEAR POWER — K. Dawson and G. Long — *Philosophical Lib.*, 208 p., illus., \$10. Two British scientists give a broad picture of the part played by chemists in the development of nuclear power.

JOURNAL OF LIPID RESEARCH, Vol. I, No. 1 — D. B. Zilversmith, Ed. — *Lipid Research, Univ. of Tenn.*, 138 p., illus., \$2, quarterly, annual subscription \$6. Offers original work in the chemistry, biochemistry, enzymology, histochemistry, and physiology of lipids.

A SHORT COURSE OF ORGANIC CHEMISTRY — John E. Leffler — *Macmillan*, 201 p., illus., \$5.50. One-semester course primarily for students majoring in fields other than chemistry.

PRINCIPLES OF ORGANIC CHEMISTRY — T. A. Geissman — *Freeman*, 635 p., illus. by Roger Hayward, \$7. Introductory course, presenting theory as an integral part of the behavior of organic compounds.

LIQUIDS AND LIQUID MIXTURES — J. S. Rowlinson — *Academic*, 360 p., \$12. For graduate students, chemists and physicists, this book summarizes our present knowledge of liquids and their properties in terms of the intermolecular forces.

SOURCE BOOK OF INDUSTRIAL SOLVENTS, Vol. III: Monohydric Alcohols — Ibert Mellan — *Reinhold*, 276 p., \$10. Presents physical properties, azeotropic mixtures and uses of industrial alcohols, methods of manufacture and newer methods of fermentation.

PRINCIPLES AND PRACTICE OF GAS CHROMATOGRAPHY — Robert L. Pecsok, Ed. — *Wiley*, 226 p., illus., \$6.75. Outgrowth of an introductory course in gas chromatography, a field whose phenomenal growth is reflected in the fact that three-fourths of the 710 papers listed in the bibliography have appeared in the last three years.

PLASTIC MAGIC: The Material of a Million Uses — C. B. Colb — 48 p., illus., \$2. Quick survey for the layman of the field of plastics, the different kinds, special uses and ways in which they are made.

THE CHEMICAL WARFARE SERVICE: Organizing for War — Leo P. Brophy and George J. B. Fisher — *Off. of Chief of Military Hist., Dept. of Army (Govt. Print. Off.)*, 498 p., illus., \$4. The history of gas warfare preparations during World War II

THEORETICAL ORGANIC CHEMISTRY: Kekulé Symposium, organized by the Chemical Society, London, September 1958 — International Union of Pure and Applied Chemistry, P. E. Verkade and others—*Butterworths (Academic)*, 298 p., \$9.50. Papers on chemical bonding and structure, nucleophilic reactions, electrophilic, and homolytic reactions.

ORGANIC CHEMISTRY — Melvin J. Astle and J. Reid Shelton — *Harper*, 2nd ed., 771 p., illus., \$7.50. Text presents theoretical discussion of organic chemistry, at the same time calling attention to its applications in industry.

CHEMICAL CALCULATIONS — H. V. Anderson — *McGraw*, 305 p., paper, \$2.75. Emphasis on solving problems, reprint.

AMINO RESINS — John F. Blais — *Reinhold*, 220 p., illus., \$4.95. Covers urea and melamine resins, and the newer ethylene urea and benzoguanamine.

THE CHEMISTRY OF PLANT GUMS AND MUCILAGES and Some Related Polysaccharides — F. Smith and R. Montgomery — *Reinhold*, 627 p., \$18. Comprehensive monograph.

THE ESSENTIALS OF CHEMISTRY — Alfred Benjamin Garrett, Joseph Fredric Haskins and Harry Hall Sessler — *Ginn*, 2nd ed., 608 p., illus., \$2.50. Introductory level college textbook.

ORGANIC CHEMISTRY — Donald Cram and George S. Hammond — *McGraw*, 712 p., \$8.50. Beginning text with subject matter organized according to classes of compounds.

GENERAL CRYSTALLOGRAPHY: A Brief Compendium — W. F. de Jongh with J. Bouman, transl. from Dutch — *Freeman*, 281 p., illus., \$5. Modern view of geometric, structural, chemical and physical crystallography.

TANTALUM AND NIOBIUM — G. L. Miller — *Academic*, 767 p., illus., \$23.50. First comprehensive review of the science and technology of the metals, incorporating results of latest international research.

THE PROTON IN CHEMISTRY — I. P. Bell — *Cornell Univ. Press*, 223 p., \$4.75. Based on lectures given at Cornell in 1958.

A GUIDE-BOOK TO BIOCHEMISTRY — Kenneth Harrison—*Cambridge Univ. Press*, 150 p., \$3.50; paper, \$1.95. Very concise textbook.

Pin-Sized Space Thermometer

➤ A THERMOMETER housed in a tiny tube shorter than a common pin can measure temperatures close to absolute zero (minus 459.7 degrees Fahrenheit). Developed by scientists at Bell Telephone Laboratories, Murray Hill, N. J., the germanium resistance thermometer may be sent up in space vehicles to help give "weather" re-

ports on outer space. The resistance of the part of a germanium crystal in the "heart" of the thermometer increases rapidly as the temperature falls.

To find the temperature an electric current is sent through the thermometer and the resistance afforded by the germanium is measured.

Chemistry Comments

Interesting facts in the chemical world.

Smallpox vaccine, the world's oldest vaccine, was discovered by Dr. Edward Jenner in 1796.

More than 6,000,000 tons of uranium ore were produced in western United States in fiscal 1959, as compared with 54,000 tons in fiscal 1948.

It has been estimated that 20% of all U. S. "liberty" ships built during World War II were seriously damaged or destroyed by hydrogen-caused embrittlement of metal.

There are 22 amino acids, ten of which are considered essential for humans.

Elementary schools today enroll 2%, secondary schools 19.9%, and colleges and universities 8.1% of this country's total school-college enrollment.

The estimated U. S. investment in uranium processing plants increased from \$4,200,000 in 1948 to \$156,200,000 in 1958.

Low molecular weight polyethylenes are widely used for paper board coatings because they are readily dissolved in waxes and can be run on conventional waxing equipment.

The vitamin C concentration of a level orange is especially high in the orange colored portion close to the surface of the peel.

Domestic flake graphite is used in lockings, pencils and lubricants, and as a material in the manufacture of crucibles.

➤ Lithium-7 has a low degree of neutron absorption, making it and its compounds useful as a coolant and coolant-water corrosion-preventing additive in nuclear reactors.

➤ Depending on the methods used, production of a ton of steel requires from 6,000 to 110,000 gallons of water.

➤ More than two-thirds of all the natural gas now stored underground in the U. S. is located in Pennsylvania, Ohio, Michigan and West Virginia.

➤ Honey is a valuable vehicle for certain medicinal preparations.

➤ In the photosynthetic process, the plant chlorophyll, or green pigment, harnesses sunlight energy.

➤ Photographs exhibiting the presence of particles of anti-matter called antilambdas, have been taken in the new six-foot bubble chamber at the University of California's Lawrence Radiation Laboratory.

➤ Adding a fungicidal chemical to asphalt varnish used in painting tree wounds prevents growth in the paint of fungi that cause decay in shade trees, and may provide protection of tree wounds from decay infection.

➤ According to Einstein's theory of relativity, no particle speed can ever quite reach the speed of light, the energy gained by the particle takes the form of increased mass.

➤ Magnesium sublimates in a vacuum and effectively disappears.

- Nitrous oxide, commonly called "laughing gas," was discovered by Sir Humphrey Davy 150 years ago.
- It is theoretically possible by the use of certain chemicals in conjunction with gamma radiation to induce polymerization of the fibers of softwoods, to make the equivalent of hardwoods.
- Automobile tail light lenses made from acrylic resins are optically more efficient than glass, yet have reduced manufacturing costs about 70%.
- Titanic jet-like surges of elemental particles are shot out of the sun at unpredictable intervals with speeds of 1,000 miles a second.
- There are 70 member countries in the International Atomic Energy Agency.
- Nickel, added to molten steel in metallic form, increases toughness, strength, and ductility in steel and, in large amounts, increases resistance to heat and acids; it is one of the principal alloying elements in making stainless steels.
- Ozone, a form of oxygen that occurs in minute amounts in the atmosphere, can be used as an excellent tracer of air movements in the lower half of the stratosphere.
- The U. S. Pharmacopeia added 742 new drugs in the 20 years from 1935 to 1955, four times as many as in the previous two decades from 1915 to 1935.
- Basic research cost the pharmaceutical industry more than \$16,000,000 in 1953 and more than \$35,000,000 in 1958.
- DDT rushes to get out of suspension in water either by evaporation or by clinging to the walls and bottom of containers.
- In 1806, morphine, the principal and most active alkaloid of opium, was extracted by a German pharmacist.
- Columbium is used in some stainless steels designed to be welded at high temperatures; the element helps prevent changes in the steel's crystalline structure.
- Ferrokinetics, the study of the dynamic metabolism of iron following intravenous injections of tracer doses, has been very useful in the study of iron metabolism.
- Epoxy resins are made from natural gas plus liquefied petroleum gas and oxygen.
- The U. S. Coast Guard has approved an all plastic lifeboat, after a series of gruelling tests, and the boat may now be used on all American flag cargo and passenger vessels.
- Europe's first privately owned and operated nuclear research reactor has started operations in Saluggia, Italy.
- Insecticides of great potency, including systemic ones that enter into the protected plant itself, have been developed in recent years in efforts to reduce the estimated \$4 billion annual loss to American agriculture from farm insects.
- The Stanford Research Institute estimates that radioisotopes will contribute, in savings to agriculture, a minimum of \$180,000,000 a year for the next 20 years.

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